PRACTICAL
ENGINEER

VOL. XV CHICAGO, AUGUST, 1911 No. 8

POWER PLANT OF RAILROAD REPAIR SHOPS

THE NEW YORK CENTRAL AT WEST ALBANY, N. Y.

THESE shops have been maintained at West Albany, N. Y., for some time past, but recently the demand has made it necessary to nearly double their power plant. The power at this installation is used for a great variety of purposes; lighting, both alternating and direct current, power for a large number of motors at 2 different voltages, direct steam heating system as well as a certain amount of fan heating and ventilation, compressed air service and hydraulic power, all have to be provided from the central station of the shops.

In consequence of the many different varieties of power as outlined above, there is a miscellaneous collection of units and it is extremely necessary that a steady and continuous operation of the prime movers and the boiler plant should be accomplished. Accordingly throughout the design of the station and the selection of apparatus great care has been exercised toward this end. It was foreseen at the time the original plant was designed that future expansion would have to be provided for and the layout was made with this in view, so that when it became imperative to make additions it was possible to do so without interrupting either the continuity of the machinery arrangement or the service of the plant. In an installation of this character where rush work is the rule rather than the exception this feature of uninterrupted service is of particular importance.

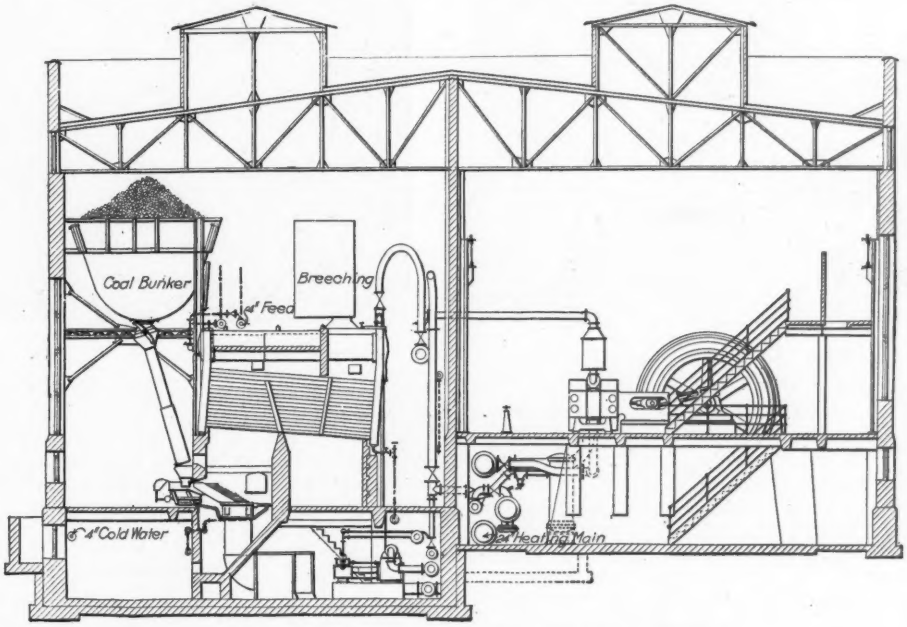


FIG. I. CROSS SECTION OF WEST ALBANY STATION

Building and Arrangement

THROUGHOUT the design of the station there is an entire absence of abnormal features and the general simplicity of arrangement makes for flexible control and economical operation as well as a maximum convenience in handling on a sectionalized basis, and the ready establishment of steady running conditions. The construction of the station building itself is of the

brick and steel type while the roof is of reinforced concrete. The boiler room, which is 179 ft. long by 44 ft. wide is laid out parallel to the engine room which measures 198 ft. by 48 ft.

Under both boiler and engine rooms are basements in which are located the auxiliary steam and electrical equipment. Slightly more than one-half of the completed plant is comprised in the original station and the new equipment is added on to this as a straight line extension both of boiler house and engine room.

The boiler room is divided into 3 sections of boilers in a single row; 3 600-hp. Edge Moor water-tube boilers are located in the new part of the boiler house and are connected to the new stack which stands outside the boiler house proper in an angle formed by the end of the boiler house and the overlaping side of the

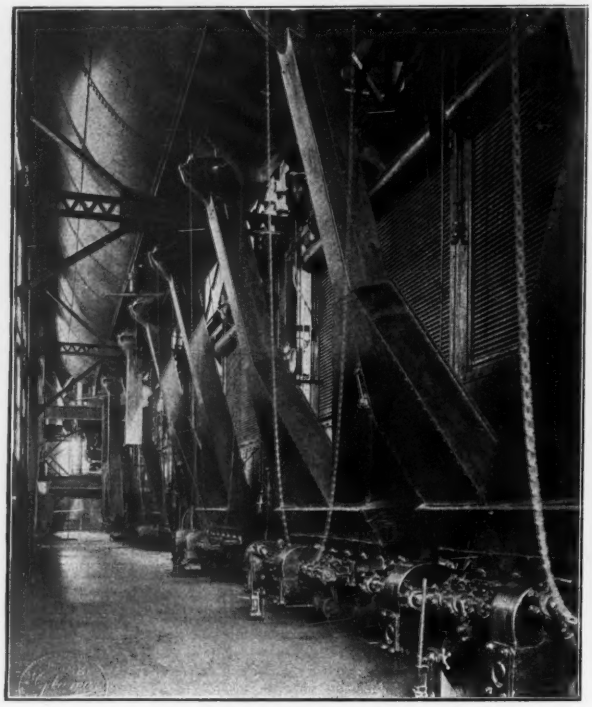


FIG. 2. LOOKING DOWN THE BOILER ROOM

engine room, and 4 500-hp. Franklin water-tube boilers divided into 2 sections feed the old stack which stands between these sections.

The Edge Moor boilers are of standard water-tube style, being 15 tubes high, 21 tubes wide and having 2 drums. These boilers have 6128 sq. ft. of heating surface and according to the rule of the manufacturer are classed as 613 hp., allowing 10 ft. heating surface per horsepower.

The drums are made of 7-16 in. plates, double butt strapped, and double riveted, the boilers being built for 200 lb. working pressure. The distance between the headers is 17 ft. 10½ in., size of steam outlet which is located on the rear header is 8 in. The man holes are in the rear header. These boilers are fitted with 3 cross pass, the flue being in the rear above the boiler and the suspended type of setting is used. Tubes are of charcoal iron No. 10 gage and the piping for the water column, etc., is brass.

In these boilers the water line is carried at the center line of the drums, which gives a large water surface and maintains an even water level, while the cubical contents of the boiler for water and large steam space afford abundant reservoirs for stored power. With the type of setting used, the boiler is free to expand and contract with changes in temperature without touching the brick work of the setting.

There were 2 5-in pop valves for each boiler, and also a 12-in. steam gage, both Ashton make. Water columns are No. 5 Reliance, with high and low alarm. Try cocks and water gage fittings are ¾-in. brass of P. B. Huyette make, and the feed and check valves were 2½-in. screwed, Hancock brass valves, extra heavy. A Pratt and Cady blowoff cock and a Faber blowoff valve, all 2½-in., are used in the blowoff pipe from each boiler.

Both the old and new boiler installations are equipped with Taylor Gravity Underfeed Stokers manufactured by the American Ship Windlass Co., Providence, R. I. In the older installation the stokers are of the 6 retort type, while the Edge Moor boilers are provided with 7 retort stokers.

Engine room units are arranged in a single row parallel with the battery of boilers. The main generating units of the plant consist of 2 600-kw. General Electric alternating-current generators driven by 2

FIG. 7. VIEW OF UPPER RUN OF COAL CARRIER

900-hp. Ball and Wood horizontal cross-compound engines and 2 500-kw. Western Electric alternating generators driven direct by 2 750-hp. Ball and Wood horizontal cross-compound engines. Of this equipment the 600-kw. machines were a part of the original plant and the smaller units were added at the time of the recent increase in the station.

Coal Handling

COAL supply for the boilers is brought by rail onto a siding from which the fuel is discharged into a 16 by 16 suspended steel track hopper provided with a Link-Belt reciprocating feeder for uniformly feeding the coal to the 28 by 24-in. 2-roll crusher. If crushed bituminous or anthracite coal is used a gate is placed in the reciprocating feeder plate and the coal passes over the end through the bypass chute onto the apron conveyor. The run-of-mine coal after passing through the crusher is also delivered onto this same apron conveyor, which in turn delivers it to the lower run of the Peck carrier. This is all clearly shown in Fig. 5. The coal is then carried by the carrier horizontally to

the end of the power plant, then vertically to the overhead Berquist bunker, in which it is uniformly distributed by means of the movable carrier dumping device, shown in Fig. 6.

From the overhead bin the coal is fed directly to the stoker magazines through steel stoker spouts, which are pivotally hung from the gate castings on the bottom of the bunker so that they can be swung back against the wall in case it is necessary to remove boiler tubes or repair the stokers. These spouts are provided with Link-Belt undercut gates at the upper end so that the coal can be shut off at any time.

Ash is drawn from the hoppers under the stoker grates into the lower run of the Peck carrier through the ash holes, shown in Fig. 5. It follows the same path as the coal and is discharged into a malleable iron apron conveyor which carries it to the ash bunker, which is located outside of the power house, directly over the suspended track hopper. This is clearly indicated in the end view Fig. 5.

The Peck carrier and ash conveyor are driven by one 15-hp. alternating-current motor and the crusher, reciprocating feeder and apron feeder are driven by a 5-hp. motor. The outfit has a capacity of 40 tons per hour of bituminous coal and is capable of handling ash at the rate of 30 tons per hour. The speed of the Peck carrier is 40 ft. per minute and of the ash conveyor 20 ft. per minute.

The combined storage capacity of the entire bunker equipment is about 800 tons.

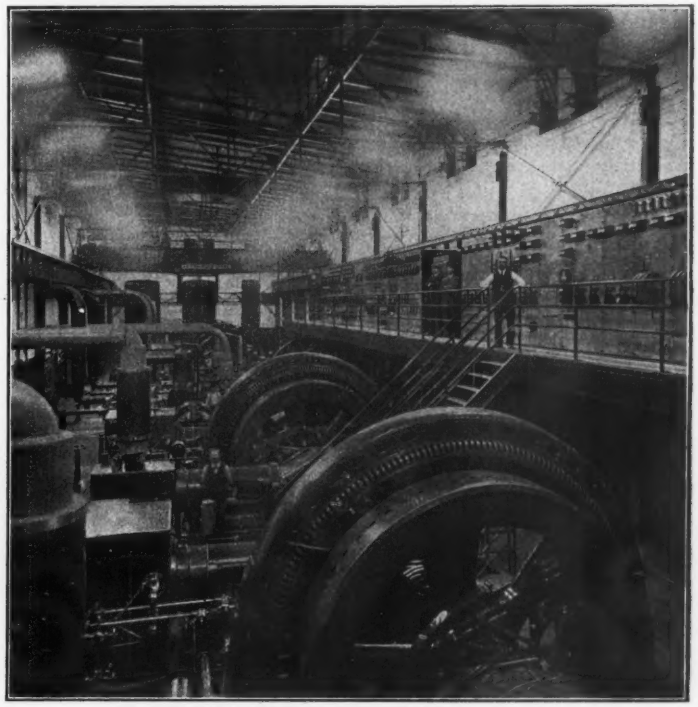


FIG. 3. GENERATING UNITS AND SWITCHBOARD

zontal duct running under the boiler room floor in line with the boiler fronts. From this duct short branches lead into a wind box under each stoker for supplying the necessary air for combustion, and from this

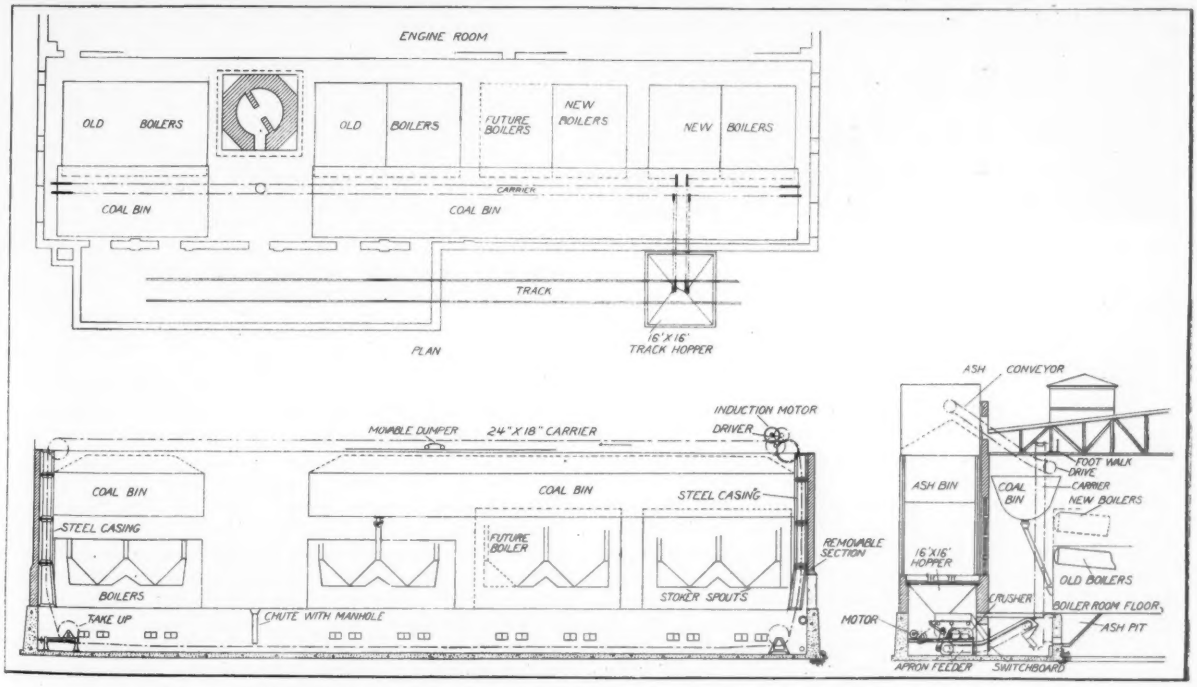


FIG. 5. PLAN AND ELEVATION OF PLANT SHOWING METHOD OF HANDLING COAL AND ASH

The stokers are provided with a forced draft apparatus consisting of fans capable of delivering 60,000 cu. ft. of air a minute at 4 in. water gage, and a horiwindbox the air is forced through a series of tuyeres in the inclined grate of the stoker. The grate consisting essentially of parallel rows of triangular steps be-

tween which operate the rams for feeding the coal is inclined at an angle of about 45 deg. and the combination of the slow feeding action of the rams and gravity causes a gradual movement of fuel bed downwards and toward the rear end of the stoker where the burned out fuel gradually piles up on the dumping plate in the form of ash.

The dumping plate is dumped by the fireman by means of a rod extending through to the front of the boiler and the ash is deposited in hoppers beneath the boiler.

This boiler and stoker equipment is capable of being forced to a remarkable extent, the 3 Edge Moor boilers each being designed for continuous operation at 200 per cent of load. The design and the provision

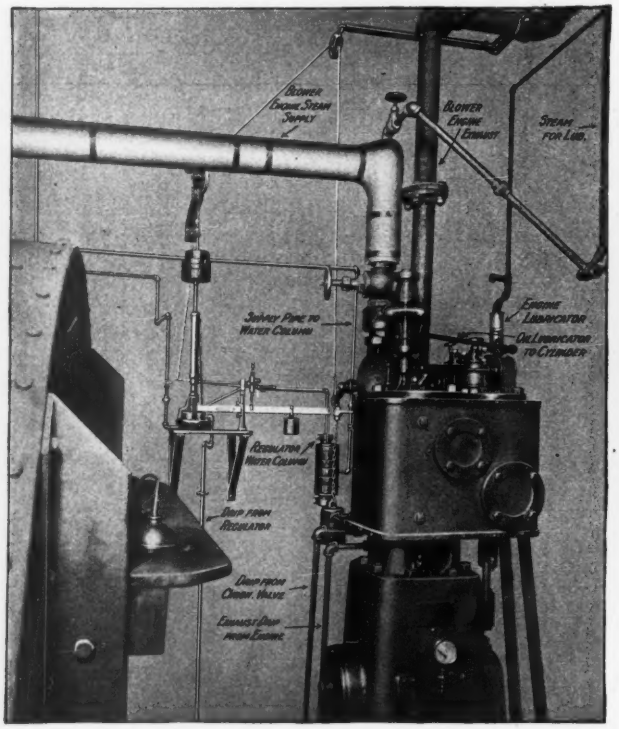


FIG. 4. SYSTEM OF CONTROL OF THE STOKER ENGINE WHICH ALSO DRIVES THE BLOWER

for automatic control of proportions of coal and air peculiar to the Taylor stokers enable them to handle as large an overload as the boiler can stand, it being necessary merely to speed up the stoker driving engine to increase the capacity of the outfit.

Switchboard and Electrical Equipment

ON the side of the engine room opposite to the boiler wall is located a marble switchboard having mounted upon it all the electrical control and measuring instruments for the plant. The switchboard stands on a gallery about midway of the length of the engine room making it easily accesible. The usual electrical auxiliary equipment such as exciters, motor generators, etc., is provided.

For lighting distribution around the shop yards and buildings, the voltage is raised from the 480 volts of the busbars to 2300 volts through 3 200-kw. and 3 100-kw. transformers located in the station basement. There are 2 sets of busbars provided in order to facilitate the separation of the lighting and power services, and a Tirrell regular enables the generating units to be operated in multiple on a common load, if necessary. The switchboard is provided with integrating wattmeters for measuring the output of the generators on both direct and alternating-current service.

Shop service includes 2300-volt 3-phase light and power circuits and 250-volt direct-current circuits. For the supply of the latter there are installed in the engine room 2 300-kw. and 1 75-kw. General Electric motor generators. The smaller set is driven by an induction motor, but the 2 larger outfits are operated by synchronous motors which are of great use in keeping up the power factor of the system, which would otherwise be low due to the large number of induction motors in operation and the consequent increase in wattless current and decrease in economy. There

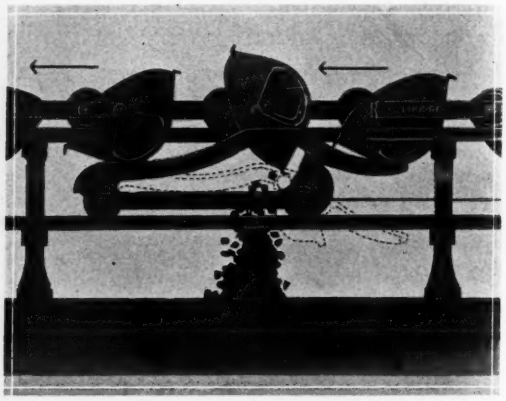


FIG. 6. MOVABLE DUMPING DEVICE

are about 300 motors of various types varying in size from 5 to 75-hp. in the shops, about 60 per cent of which operate upon alternating current.

Hydraulic and Compressed Air Equipment

HYDRAULIC power is furnished for quite a number of uses and to supply this system a 3,000,000-gallon main service pump is among the auxiliary equipments. Compressed air is used to a very large extent for testing the air brake systems of trains standing in the yard, for the operation of pneumatic tools, boiler tube cleaners and various other service. Two Ingersoll-Rand steam driven air compressors rated at 360-hp. each supply the air at an average pressure of 90 lb. per square inch and the shop consumption is approximately 95,000,000 cu. ft. per month at this pressure.

Main engine units are operated noncondensing, exhausting to the atmosphere in the summer and in winter to the heating system of the shops through 2 24-in. exhaust mains, one running to the north end of the property and the other to the southern part.

A low-pressure automatic heating valve is located in a supply line from the high-pressure main to the heating main for supplying live steam, if necessary.

and a pressure reducing valve in the exhaust main supplies low-pressure steam to the heating system. A Knowles vacuum return pump is installed in the power house basement to handle the returns from the heating system.

For the class of service required of a plant of this description it is of particular importance to contain continuous operation and to be able to meet the demands of rush orders. This fact taken in conjunction with the rather heterogeneous power types embodied in the various shops made it extremely desirable to install only the most reliable types of equipment in the power house and the excellent service obtained has justified the selections made.

The average electrical output of the plant during the summer is 800 kw. hr. a day and in winter 1200 kw. hr. The entire capacity at present installed is 2200 kw. Although the main engine units are operated noncondensing, the economy throughout the year is considerably better than that of many central stations of corresponding size, the current being produced at an average cost of approximately 0.8 cent per kilowatt hour at the busbars. This showing in itself is sufficient commentary on the efficient operation of this plant.

HEATING BY VAPOR

USING BOTH VACUUM AND PRESSURE

By E. W. Klein

THIS system of heating is popular in and around Atlanta, Ga., where it has been used in a great number of large installations, and for residence work as well. Inasmuch as it possesses several unusual features, a description of its installation and operation will be interesting and valuable.

It is a 2-pipe system without air vents on the radiators, all condensation being returned to the boiler by gravity. The supply connection is made at the top of the end section of the radiator, hot water radiation being used exclusively, the return connection is made at the bottom at the same end. In case wall radiators are used, or radiators under 22 in. high and over 5

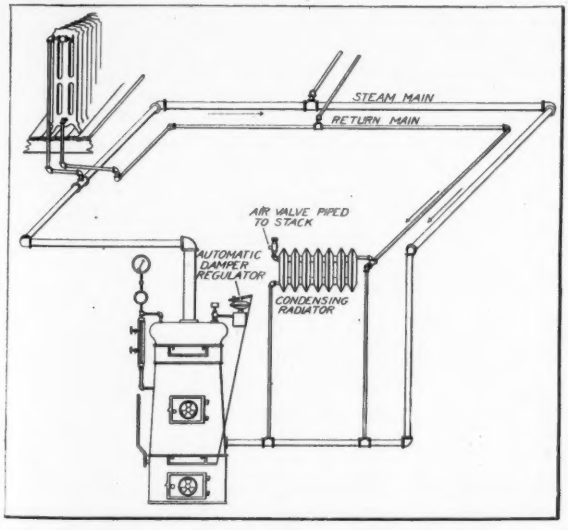


FIG. 1. CONNECTIONS OF VAPOR SYSTEM FOR VACUUM OR PRESSURE

ft. long, better results are obtained by making connections top and bottom at opposite ends.

Supply connections are generally made through graduated or fractional valves preferably of packless type, and return connections through a special union elbow with a water seal and ball check. Supply connections are made ¾ in. up to 100 sq. ft., 1 in. up to 200 sq. ft. and 1¼ in. over 200 ft. The return connections are uniformly ½ in.

A table of sizes of mains is given herewith. All pipes should be carefully reamed so as to get full openings, and must pitch or grade in the direction of the flow of steam so that the condensation will flow with the steam. Steam branches should generally be made one pipe size larger than risers or stubs; this is not necessary in the case of return branches. In case of long laterals the size should be increased. Radiation is figured to give off 275 B. t. u. per hour per square foot.

Sketch of a typical plant is shown in which it will be noticed that the return line follows and grades with the steam line.

Description of Operation

THE Auditorium and Armory Building of Atlanta is heated by one of these systems, with steam generated by an ordinary cast-iron sectional boiler. The largest pipe in the building is 4 in. There are several 3 column 38-in. radiators with 235 ft. of radiation each in this installation, these radiators being 10 ft. long and fed through a 1¼-in. valve; the return connection is through a ½-in. special elbow.

After firing up this boiler, and before the gage registers any pressure whatever, in fact as soon as vapor

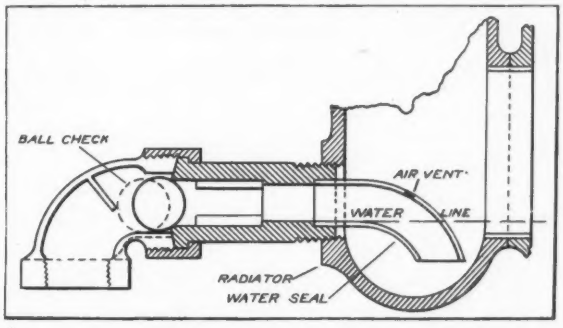


FIG. 2. UNION ELBOW FOR RETURN CONNECTION

can be seen from the gage cocks, the radiators commence to warm up.

One of the advantages of this system over many others lies in the fact that the radiations may be proportioned the same as for a straight steam job. During mild weather the damper regulator is adjusted for a pressure of 4 or 5 ounces and the plant is operated as a vapor plant. As soon as the weather is colder, the damper regulator is adjusted for 2 lb. and the plant is operated as a straight steam job. This is possible because the automatic air valve is so constructed that it shuts off to steam. The automatic air valve also has a vacuum attachment which pre-

vents air from entering the system in case the steam pressure should fall below atmospheric pressure.

Adjustment of the damper regulator from 4 ounces to any other desired pressure is accomplished by moving a weight along a lever and requires but a moment.

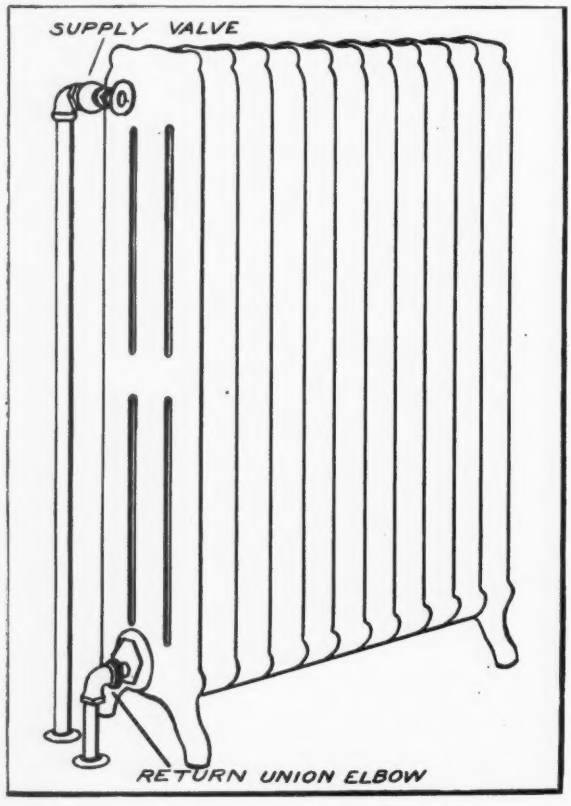


FIG. 3. RADIATOR SHOWING CONNECTIONS

With this system all the advantages of a vapor system are obtained, without the additional cost for that of the extremely cold days with straight vapor. On a cold day the pressure is increased but this is very seldom necessary in the Atlanta climate.

Detail of Action

THE automatic damper regulator is set at any pressure which is desired, and automatically maintains this pressure on the system by acting on the draft dampers on the boiler.

Steam or vapor is generated in the boiler and enters through the system into the radiators at the point marked "Supply Valve." As this steam condenses, water collects in the bottom of the radiators until it rises to the water line of the water seal elbow in the radiator, after which the condensation passes into the return system.

As soon as the supply valve on a radiator is opened, the ball check valve rolls away from its seat and allows condensation to pass freely into the return system. If the supply valve is now shut, the check valve rolls on the seat and prevents any water or vapor from backing into the radiator through the return system. This return valve is entirely automatic and requires no attention and cannot get out of order. The water seal on this return valve prevents any vapor from escaping from the radiator into the return system. All of the vapor must be condensed in the radiator except the little which passes through the air vent opening with the air.

This air vent opening serves 2 purposes. It equalizes the pressure on both sides of the water seal and prevents this from syphoning out. It also allows the air in the radiator to escape into the return system as soon as the supply valve is opened.

Just before the return main reaches the boiler, a condensing radiator is connected to it. This connection is taken off the top of the main so that all water of condensation passes by and into the boiler, but all vapor and air in the system is passed into the condensing radiator, which by condensation maintains a partial vacuum on the system.

All air is released from the system by means of an air valve on the condensing radiator which automatically releases any air but closes off to steam, this air valve is piped into the flue which helps to create a vacuum on the system.

A return connection to the condensing radiator removes the water of condensation.

With this system it is possible to have any fraction of the radiator warm, and thus have a comfortable room with any outside temperature.

SUPPLY AND RETURN PIPE CAPACITIES FOR VACUUM-PRESSURE VAPOR SYSTEM

Size of Pipe	Length of Main										Minim. Size Return	Usual Factors for Reducing lineal ft. Pipe to H. S.	
	1	10	50	100	200	400	600	1000	1500	2000			
	Square Feet of Radiating Surface												
¾	350	175	85	65	50	40	35	30	25	20	½″	.28	3.63
1	650	360	180	120	100	80	70	60	50	45	½″	.33	2.90
1¼	1110	625	320	240	190	150	130	110	90	80	½″	.43	2.30
1½	1670	1000	530	390	310	250	210	180	150	135	½″	.50	2.01
2	2810	2000	1130	870	670	540	460	390	330	290	¾″	.62	1.61
2½	4470	3440	2050	1600	1250	1000	870	740	620	550	¾″	.74	1.32
3	6500	5230	3270	2590	2040	1650	1430	1210	1020	900	1″	.92	1.09
3½	8900	7430	4860	3900	3100	2500	2190	1850	1570	1390	1″	1.05	.95
4	11660	9990	6760	5480	4390	3630	3120	2630	2230	1960	1¼″	1.19	.84
4½	14390	12580	9040	7270	5810	4660	4260	3510	3080	2710	1¼″	1.31	.76
5	18330	16280	11720	9720	7900	6460	5680	4810	4210	3630	1¼″	1.61	.62
6	26360	24190	18330	15800	12870	10380	9390	7980	6720	5040	1½″	1.75	.57
7	36150	33530	26360	22840	19090	15930	14120	12040	10290	9130	1½″	2.	.50
8	47260	44410	35990	31620	26910	22680	20180	17120	14330	12720	2″	2.23	.44
9		56600	46620	41420	35580	30170	26920	23150	19790	17380	2″	2.56	.39
10			60460	53650	46710	40050	35860	30890	26540	23610	2½″	2.85	.35
12					73210	63870	57660	49950	43080	38400	2½″	3.45	.29
14							86400	75430	65310	58290	3″	4.	.25
15									85770	71910	3″	4.17	.24

Note:—Length of main is distance to farthest radiator. Make deductions for unusual exposure.

PATENT BOILER COMPOUNDS

WHAT HAVE BEEN PROPOSED AS INGREDIENTS

By F. W. Salmon

WHEN Smith, the boiler compound saleman calls, and talks about the "patent" boiler compound that he is selling you wonder what's in it. Get him to tell you the patent number, and the table will tell what it is composed of, at least by the patent.

One "Smith" informed me that the best boiler compounds were not patented, that patents were taken out by "cranks" and what did cranks know about compounds! Well, Mr. Smith, what about that man who has 40 years of experience or more, and is highly thought of by his professional brethren and keeps his boilers clean with his own composition, and wished to patent it, but has spent a goodly share of his money experimenting on these lines, and finally the banker down town pays the expenses of securing the patent for a ¼ interest.

Do you suppose that a successful middle aged banker puts up his money without expert advice?

Nevertheless, every boiler compound that is "patented" is not a panacea for all boiler troubles, and possibly some mixtures patented under the name of "boiler compounds" might be injurious to some boilers under certain circumstances. Nevertheless, it is interesting and instructive to study this table covering the patents that I found in the Official Gazette of the United States Patent Office for the years 1898 to 1910 inclusive, and I can assure you it took some searching and reading.

Perhaps you think that you have a good compound, that is "new and novel and useful" as the patent specifications generally state; then just read over all the compositions that are given and remember that, if you will send a post office money order, for 5 cents to the Commissioner of Patents, Washington, D. C., with a request that he send you a copy of the patent of which you give the number (as shown in the table) if there are copies in print, he will send one to you. Then you will have the whole claims, and specification, etc., and can compare every item in detail with your proposed composition.

UNITED STATES PATENTS ON BOILER COMPOUNDS

Issued	Patent		Inventor		
	Date	No.	Name	Place	
1898	Jan. 8, 1898	605320	G. Linde	Omaha, Neb	Gallic powder, salammoniac, soda, salt, acetic acid, catechu and Irish moss.
1899	Nov. 28, 1899	629409	J. Wilson	New York	Sodic chloride, alumina, sulphate of alumina; to precipitate impurities.
	Nov. 28, 1899	628410	J. Wilson	New York	Sodic chloride, alumina, sulphate of alumina and lime.
	Nov. 28, 1899	629411	J. Wilson	New York	Sodic chloride, alumina, sulphate of alumina lime and soda.
1900	Nov. 1, 1899	653008	C. H. Koyl	New York	Sodium hydroxide and ferrous sulphate.
	June 23, 1899	655119	J. I. M. A. Reis	Antwerp, Belg.	58 parts sugar, 20 tannin extract + 20 silicate + 2 boracic acid and water to bind.
		646990	J. J. Hughes		Boiler Cleaning composition (Gazette, April 10, 1900).
1901	Oct. 22, 1900	668820	T. H. Jones	Chicago, Ill.	Subjecting water to contact with mercury and zinc and impragnating it with bicarbonate of soda.
	April 5, 1900	669930	Geo. Kobes	Neustadt, Ger.	Caustic soda, salt, gall nuts, catechu, sal-ammoniac, petroleum, potato flour extract, graphite, Indian root, Swedish tar, pumice.
	Aug. 4, 1900	672285	Ben Pena	Loredo, Tex.	Extract from the plant Larvea Mexicana.
	Feb. 25, 1901	683330	J. Richards	Phila., Pa.	Extra of Logwood, ground potato starch, ground borax.
1902	Jan. 4, 1901	692979	C. O. Brueckner	Ft. Wayne, Ind.	15 grs. soda ash, 23 grs. lime, 7 grs. sodium phosphate, to 5 gallons of water.
	Apr. 10, 1902	701508	J. A. Robinson	Berwind, Colo.	Water from boiled potatoes + ammonia + sal-soda + coal oil + black oil + wood ashes + sulphur + dung of animals that chew their cud.
	July 5, 1902	711876	C. Nettleton	Des Moines, Ia.	Glauber's salt + soda ash + sulphate of lime + slippery elm bark.
1903	Jan. 27, 1903	719002	J. N. Henderson	New Orleans	Parched ground coffee + logwood extract + blood meal + salt + water, mixed.
	Feb. 10, 1903	720267	J. Laudenslager	Tiffin, Ohio	Catechu + potash + soda ash + German salts.
	May 19, 1903	728627	J. D. Scott	England	Catechu + molasses.
	July 24, 1903	734168	R. I. Gamlin	Bromley, Eng.	Shredded jute.
	Nov. 3, 1903	743380	W. B. Fitzp't'k	Pittsburgh, Pa	40 lb. caustic soda + 12 lb. logwood extract + 4 lb. powdered ivory black + 4 lb. zinc sulphate + 4 lb. manganese oxide.
	Nov. 24, 1903	745147	J. I. Broughton	Walkerville, Mt	Potatoes, linseed meal, tallow and black oil.
	Dec. 29, 1903	748341	Paul Bez	Leras, France	260 parts barium chloride + 40 tannin to prevent furring.
1904	April 15, 1903	750682	J. McCormack	Chicago, Ill.	Hemlock extract + soda ash + water.
	Sept. 24, 1904	770976	N. Lopez	Delrio, Tex.	Extracts of Covillea divaricate, Phragmites phragmites and Yucca.
1905	Feb. 23, 1905	787822	M. S. Bell	Mayflower, Trans.	38 6-13 black treacle + 19 3-13 Wattle bark + 9 8-13 leather shavings + 3⅓ licorice root + 28⅓ caustic soda.
	Jan. 10, 1905	792462	Cip. Salazar	Albuquerque,	1 gal. water + 12 oz. Gobernadora + 4 oz. Covillea tridentata.
	June 29, 1905	798715	L. W. Thompson	Hobart Mills,	4½ lb. potatoes + 3 lb. brown sugar + 1 qt. kerosene, make up to 1 gal. with water.
	Sept. 23, 1904	807412	J. F. Winford	St. Louis, Mo.	1 gal. of water + ¼ to 2 grs. anhydrous ferrous fluoride + 4 to 8 grs. lime.
1906	July 3, 1905	810838	P. B. Bird	New York	Water solution of alkali, vegetable acid, carbohydrate, add solution of mercury and oil
	Aug. 19, 1905	821844	J. Williams	Pittsburgh, Pa	Water, caustic soda, saltpeter, soda ash and sal soda.
	June 8, 1905	824112	J. R. Green	Washing'n, Pa.	Coffee + Balsam weed + Yarrow + pulverized graphite.
	May 25, 1904	828938	B. Kniffer	Milwaukee, Wis	To an emulsion of rosin add alum.
1907	Jan. 24, 1907	851159	G. W. Case	Lestershire, N. Y.	8% antimony + 4% aluminium + 2% bismuth + 1% copper + 10% lead + 3% mercury + 25 tin + 45% zinc.
	Sept. 27, 1906	853535	T. Di. Tullio	Quincy, Mass.	Extract quebracka, bicarbonate of soda, sal-ammoniac, pulvic eucalyptus, crystallized soda, Chinese soda.
	May 21, 1906	868149	J. Williams	Pittsburg, Pa	Sodium carbonate + sulphur + sodium hydrate + water.
1908	July 27, 1907	880126	J. I. Cooper	Pulaski, Va.	Cutch + soda ash + borax + coal oil + oak bark ooze.
	Jan. 21, 1908	893894	F. Borrios	Bejucal, Cuba	5 gals. water + 80 lb. bark of mangrove trees + 17 lb. leaves of quava trees + 3 lb. roots of soap trees.
	Feb. 29, 1908	907954	Max. Becker	Manheim, Ger.	8% ground pumice stone + 5% fine aluminum + 87% graphite.
1909	Feb. 8, 1908	911928	Geo. Wagener	Austria, Hungy	By weight 70% terra-clutch + 15% tannin + 10% quercetin + 5% borax, make into a dough with water.
	Aug. 29, 1908	913606	H. R. Young	Catasauqua, Pa	80% powdered soapstone + 18% sodium carbonate + 2% brown sugar.
1910	Feb. 8, 1910	948833	Eugene Vezie	Washing'n, Pa.	Coffee + tobacco + Epsom salts + Balsam-weed + graphite + yarrow.
	Feb. 8, 1910	948968	Cumberland	St. Kilda, Aust	Electric current through electrodes.
	Mar. 1, 1910	950582	A. M. Urista	Mexico, Mex.	Distilled alcoholic extracts of ramie, tobacco, nopal, neutieth, agave & amarylliis + water.
	Nov. 29, 1910	976894	J. Q. Maule	Terrel, Tex.	19 gal. castor oil + 19 gal crude petroleum + 2 gal. molasses.

ECONOMY IN AIR COMPRESSION*

By Lucius I. Wightman

PRIMARILY, AN AIR COMPRESSOR is to be considered as made up of 3 parts; namely, the driving element, the compressing element, and the mechanical structure combining these 2 which may be designated as the power transmitting element. The measure of efficiency of an air compressor is the ratio of the horsepower applied as initial energy, to the horsepower represented by the compressed air delivered, the inevitable losses in air compression being broadly classed under 5 headings.

First loss due to friction in the mechanical structure which transmits power from the driving to the compressing element; second, loss arising from the heating of the air during admission to the cylinder, resulting in a reduction of its density and a diminished volumetric efficiency of the cylinder; third, loss arising from the heating produced by compression, calling for more power; fourth, loss from the reduced volumetric efficiency of the cylinder due to the fact that the intake air is seldom at atmospheric pressure owing to wiredrawing in the inlet valves and passages; fifth, loss of volumetric efficiency due to the effect of the clearance air in reducing the effective length of the admission stroke.

These various losses can be kept down to the minimum by correct design and construction, but they can never be entirely eliminated. After all these losses have been deducted, the net efficiency of the machine remains, and of this Frank Richards says, "It is safe to say that the ultimate efficiency never goes as high as 80 per cent, while it often goes below 60 per cent."

Driving Element

TAKING up now the 3 primary parts into which the compressor has been divided, air compressors can be broadly defined as either steam driven or power driven.

The ordinary steam driven compressor is simply a steam engine with one or more air cylinders directly coupled on an extended piston rod. Good steam engine practice is the best compressor practice so far as the steam end of the compressor is concerned.

There is, however, one vital distinction between steam engine and compressor practice. The steam engine, for ordinary power purposes, must maintain a constant speed, irrespective of load. The steam-driven air compressor, on the contrary, in order to maintain its output of air properly adjusted to its load, must run at a variable speed, for its piston displacement or its capacity is directly proportional to its speed. This means that while the steam engine has a variable load per stroke, the air compressor has a constant load per stroke, except for the small variation of friction and compression at varying speeds.

This feature has no particular bearing upon the performance of air compressors with simple steam cylinders, but is most important in applying compounded steam cylinders to compression work. The first essential of successful steam compounding is to maintain the proper ratio of expansion. This means that for a given steam pressure, back pressure and cylinder ratio, there is one and only one proper point of cutoff for both steam cylinders.

In any given case the first and third conditions must be considered constant, leaving the second condition as the variable which is to be adjusted to meet varying conditions. Where a constant speed must be maintained, regardless of load, this must be accomplished by change of cutoff; and in compounded steam cylinders this immediately destroys the proper ratio of expansion and sacrifices economy. Constant speed practice with compound engines with variable load must be a compromise, even at the best.

Compound Steam Ends

BUT in the air compressor, where the load per stroke is constant, the cutoff of the steam cylinders remains practically constant and the correct ratio of expansion is maintained over the full load range. The word "practically" is here used advisedly, since there is bound to be a slight departure from perfect conditions to produce the necessary change of speed under varying load; but it will be evident that the air compressor offers the ideal opportunity for securing in highest degree the advantages of steam compounding.

It would appear, therefore, that in steam-driven air compressors the first element of economy lies in using compounded steam cylinders, when operating under pressures which will make the saving worth while. The peculiar operating conditions of the air compressor, just explained, justify compounded steam ends under pressures lower than would be advisable in ordinary engine practice. The largest builders of air compressors are recommending compound steam ends for as low as 80 lb. boiler pressure running condensing, and for 90 lb. running non-condensing.

The 3 fundamental advantages of compounded steam cylinders on air compressors may be summarized as follows: Lower fuel consumption and fuel cost; lower cost of boiler feed water; lower cost of boiler plant and accessories.

Power Driving

TURNING now to the subject of power-driven compressors, they are in general an evolution from steam-driven types. They differ, however, from the others in the vital fact that while steam-driven compressors are variable speed machines, power-driven compressors are, in the vast majority of cases, constant speed machines. This makes the problem of regulation quite distinct in the 2 cases.

Belts and Ropes

BELT drive is the most common and is always applicable except where a very short center makes necessary so high a belt tension that the undue pressure on shaft bearings results in excessive friction, low mechanical efficiency and rapid wear of the bearings. A good rule to follow is that the pulley center distance should never be less than 3 or 4 times the diameter of the larger pulley, and the direction of belt motion should be such as to put the slack on top. Where ample center distance cannot be had, it is much better to go to some other form of drive.

Rope drive is perhaps the next choice, although it is seldom used where the power to be transmitted is

*Abstract of paper before the Society of Engineers of Eastern New York.

small. It is particularly advantageous where short centers only can be had, as the grip of the rope in the grooves gives the necessary pulling power without undue tension and bearing friction. Durability and efficiency of the rope drive depend entirely upon the shape of the rope grooves and upon the use of a suitable number of ropes so that no one rope is under excessive strain.

Tightness, whether for belt or rope, are always to be avoided. There may be cases where there is no alternative, but probably, were the facts known, they have cost far more than they are worth in the increased repairs and larger power consumption. A recent development by one of the largest builders, however, opens up great possibilities for belt drive on close centers without any increased friction. This arrangement, the Lenix system, involves the use of a floating idler pulley and a very slack belt, the weight of the idler taking up the slack of the belt and increasing the arc of contact on the driving and driven pulleys so that the full power is transmitted without undue strain on the bearings or on the belt itself.

Geared and Direct Drive

GEAR drive and silent chain drive must be used where the demand for compactness renders them imperative. The best practice places the limit of power for gear drive with a rawhide pinion at 40 hp., gear drive with a steel pinion at 60 hp. and for silent chain drive at 50 hp.

Very modern development is the direct-connected electric driven compressor with the rotor of a slow-speed motor mounted directly on the compressor shaft. This construction is not applicable to small units because commercial conditions limit the price to be paid for a motor, and a low-speed motor of small power costs out of all proportion. On moderate and large sized machines, however, this design affords the very highest possible economy in power-driven compressors.

Recent improvements in air valve movements and in air cylinder design which permit much higher piston speeds than were before considered practical, have contributed toward the success of the direct-connected compressor unit. Unless valve and port areas are very large, the compression efficiency is so greatly reduced at the customary motor speeds as to offset the advantages of compactness. Choice of a direct-connected motor-driven compressor should therefore be determined by investigating whether the compressor has been specially designed for this method of drive, or is a standard power-driven machine specially fitted with a motor. In the latter case, satisfactory results cannot be expected.

Compression Cylinder

PROBLEMS encountered in the steam cylinder of an air compressor are those of expansion. In the compressing element we find here that the problems are those of compression, almost an exact reverse of those in the steam end. In compressing air, all of the energy applied is converted into heat. At first glance, therefore, economical considerations would seem to indicate that this heat should be retained during compression.

As a matter of fact, however, economical air compression depends primarily upon the thoroughness with which the heat of compression is removed as fast as it is produced. Compressor practice uses one or both of 2 methods for accomplishing this; namely, water jacketing, and compounding or stage compression.

Cooling During Compression

IF the piston of a compressing cylinder could move so slowly that the water in the jacket could absorb and carry off all the heat, it is evident that this jacketing process would save all the work which is represented on the indicator diagram by the area between the actual compression line and the isothermal curve. But in actual practice a compressor cannot be run so slowly and water jacketing is only a partial solution of the cooling problem.

Temperatures increase with the pressure in the cylinder and it is evident that the advancing piston steadily reduces the effective area of jacket. Near the end of the stroke, when pressure and temperature are highest, very little of the cylinder walls is exposed and the greater part of the cooling area remaining is the cylinder head. This emphasizes the importance of head jacketing and the superiority of those constructions in which the air valves are not in the heads, thus affording the largest percentage of cool head area.

But even under the best conditions water jacketing realizes only a part of the saving which its theory promises. Some beneficial effect in this respect it certainly has, particularly in slow-speed, long-stroke machines; but probably its greatest value lies in its effect upon the lubrication and the resultant wearing qualities of the machine.

Cooling and Lubrication

COMPRESSION at sea level and ordinary atmospheric temperature to only 75 lb. gage produces a temperature of about 400 deg. F. If some means were not employed to reduce this temperature, the inevitable result would be a destruction of all ordinary lubricants and packings, and the rapid wear of piston rings, cylinders, rods and valves, with extravagant leakage, loss of capacity, increased friction and excessive power consumption. But the water jacket keeps all parts reasonably cool and results in tight joints, free lubrication, little wear, reduced friction, easy running, and sustained capacity and efficiency.

ONE OF THE great sources of loss of fuel which we are apt to forget is the mine fires, and as the destruction of fuel in this way is bound to result in increased cost is a matter of interest to everyone. In a lecture delivered by Herbert M. Wilson, chief engineer of the Bureau of Mines, before the National Fire Protection Association, some interesting points are brought out. A mine fire near Carbondale has been burning for the past 10 yr., devouring hundreds of thousands of tons of coal and miles of mine galleries. Near Summit Hill, Pa., fire has been burning 51 yr. and has destroyed some $26,000,000 worth of coal. Near Jobs, Ohio, a tract of coal has been burning since 1884. Fires in metal mines are also of long duration, one at Butte, Mont., having been burning since 1889. This fire is largely among the timber of the mine. Other more recent fires have been very destructive of life and property, though not of so long duration. In nearly all cases it is found that the cause of the fire is trivial and that its spread and long continuance have been due to lack of proper means of fire fighting in the mines. The practical point is that every engineer's influence should be used in favor of proper laws in each state for mine safeguarding and protection.

WHEN TURNING STEEL or other hard metal, the use of a drip composed of 2 parts petroleum and 1 part turpentine will insure easy cutting and perfect tools.

RECENT PROGRESS IN LICENSE LAWS FOR ENGINEERS

THAT the engineers of this country and Canada have been busy in preparing proposals for license laws is evidenced by the number of bills which have been presented in various states and provinces. These bills all have for their object the protection of the people from explosions due to ignorance and carelessness in the operation of steam power plant machinery and are intended indirectly to increase the salary of competent engineers and firemen. In the majority of cases these bills got only as far as the committees, others were defeated, the only one presented in the States which passed both houses being amendments to the existing boiler inspection and license law in Massachusetts.

Proposed Bill for Pennsylvania

THE bill proposed for engineer's license law in Pennsylvania makes necessary a licensed engineer for a plant of more than 15 hp. and carrying more than 15 lb. pressure, except where the plant is under the jurisdiction of the United States and in the case of locomotives operated by railroad companies.

The chief examiner of steam engineers is to be appointed by the governor for a term of 4 years and shall be an engineer of not less than 10 years' practical experience. The chief examiner shall divide the state into 6 suitable districts, and appoint one district examiner for each district, whose term of office is 4 years from the date of appointment. These district examiners must have had 6 years' experience as practical steam engineers prior to their appointment.

It is made the duty of the chief examiner to prepare reasonable rules and regulations governing the disposition of applications and also the procedure in appeals from the decisions of the district examiners. He shall hear complaints and render final decision in cases where applicants for licenses have been refused.

An applicant is exempt from examination if he has had charge of steam boilers and engines for the 3 years immediately prior to his application for license unless he desires it. Persons holding licenses in any first, second, or third class city within the state as steam engineers shall be granted a license by district examiners without examination unless requested by the engineer. The applicant must be over 21 years of age, and must pay a fee of $3 when license is granted and $1 for each renewal. Renewals may be made each year after the license has been granted. The engineer is given a written notice of the expiration of his license 10 days prior to its expiration.

The chief examiner is placed under a bond of $10,000 and district examiners embracing the cities of Philadelphia and Pittsburgh $6,000, for each of the other district examiners and the clerk of the chief examiner $4,000.

For violation of this law on the part of the engineer a fine of not less than $5 nor more than $50 may be imposed, and on the part of a plant owner who persists in employing unlicensed engineers, a fine of not less than $10 nor more than $200 may be imposed.

Rhode Island Proposal

IN Rhode Island 2 bills have been before the legislature, one almost identical to the Massachusetts law, relative to the operation and inspection of steam boilers, and the other relating to the licensing of stationary engineers and firemen. A bill for licensing engineers has been before the legislature of this state for the past 10 years but those interested were unable to get any action on the part of legislative committeemen until it was contended that Rhode Island is the dumping ground for those not able to obtain license in other states and also for condemned boilers which have been the cause of some loss of life in the state and this has aroused the legislators to take some action, though as yet the proposed law has not become effective.

Exceptions to the law requiring licensed engineers are made in the case of locomotives, boilers used under the jurisdiction of United States marine and civil service laws, boilers on road and motor vehicles, boilers used for agricultural purposes exclusively, and boilers for private residences for heating purposes only limiting the pressure of steam to 15 lb. The punishment for violation of this law is a fine not to exceed $300 or imprisonment not exceeding 3 months, or both.

An engineer or fireman in charge of a plant for one year prior to the passage of this law shall be granted a license for the plant he is operating and none other.

The bill calls for the appointment of an examiner by the governor. This examiner shall have had not less than 10 consecutive years of practical experience and shall act as examiner of engineers and firemen and see that the law is enforced. His term of office will be 3 years.

The bill further calls for the appointment by the governor of a board of appeals, consisting of 3 practical engineers their terms of office also being 3 years. The members of this board shall be paid $10 per day while in executive session.

All licenses shall continue in force for 3 years from the date of issue unless revoked and may be renewed without further examination. Engineer's licenses are divided into 4 classes: First class, to have charge of and operate any steam plant; second class, limits the holder to engines which do not exceed 150 hp. or assistant to a first class engineer; third class, is limited to boilers not exceeding in the aggregate 150 hp. and an engine not exceeding 50 hp., or to operate a second class plant under the engineer in direct charge of the plant; fourth class, covers hoisting and portable engines and boilers.

Firemen's licenses are as follows: Extra first class, unlimited boiler plants. First class, limited to boilers where the pressure carried does not exceed 25 lb., or to assistant in first class plant. Second class, limited to an assistant's position.

Any person may appeal from the decision of an examiner to the full board of appeal with 30 days, whose decision is final.

The bill before the Rhode Island legislature relative to the operation and inspection of steam boilers requires that all steam boilers and their appurtenances, except boilers for railroad locomotives, motor road vehicles, boilers in private residences, boilers in public buildings and in apartment houses used solely for heating and carrying pressures not exceeding 15 lb. per square inch and having less than 4 sq. ft. of grate surface. boilers of not more than 3 hp., boilers used for horticultural and agricultural purposes exclusively, and boilers under the jurisdiction of the United States, shall be thoroughly inspected internally and externally at intervals of not over one year and shall not be operated at pressures in excess of the safe working pressure stated in the certificate of inspection, which pressure is to be ascertained by rules established by the board of boiler rules, and shall be equipped with such

appliances to insure safety of operation which shall be prescribed by the board of boiler rules.

Inspection of boilers and appurtenances shall be made by the boiler inspection department under the supervision of the chief inspector of boilers or by inspectors of such insurance companies as have complied with the laws of the state and are authorized to insure steam boilers. No insurance company shall issue a policy of insurance on a steam boiler for a longer period than 3 years.

The board of boiler rules shall consist of 5 persons to be appointed by the governor. The board is constituted as follows: One chief boiler inspector who has been a practical operating steam engineer with at least 10 years' practical experience, who shall be chairman of the board, one member representing the boiler using interest, one member representing the boiler manufacturing interest, one member representing the boiler insurance interest and one member who is a practical operating engineer.

A board of appeal, also appointed by the governor, consists of 3 engineers of at least 10 years' practical experience, whose duty is to hear and consider all appeals from the decisions of the inspectors. They shall receive for their services a compensation of $10 a day while in executive session.

It will be noted that in this bill the boiler inspection and licensing boards are distinctly separate, each having its specific duties. This differs from the Massachusetts law in that the examining of engineers for license is done by members of the boiler inspection department.

Points in the Kentucky Bill

IN Kentucky a bill providing for the examination and licensing of steam engineers was introduced in the legislature and had the backing of the engineering societies in the state. This bill provided for one chief examiner to be appointed by the governor and who should divide the state into 3 districts over which he shall appoint 3 district examiners of engineers.

The chief and district examiners hold their offices for a term of 4 years but may be removed by the governor for failure faithfully to discharge their duties.

Candidates for chief examiner must have had at least 10 years' pratical experience as steam engineers previous to appointment, and candidates for district examiners must have had not less than 7 years' experience as engineers.

The chief examiner is given authority to issue such instructions, make such rules and regulations for the government of the district examiners as he may think necessary for the carrying out of the license law.

The boilers which do not come under this act are boilers for locomotives, motor road vehicles, boilers in private residences, boilers in apartment houses of less than 5 flats, boilers under the jurisdiction of the United States, boilers used for agricultural purposes exclusively, boilers of less than 8 hp. and boilers used for heating purposes exclusively which are provided with a device approved by the chief examiner limiting the pressure carried to 15 lb.

No person shall be eligible for examination for a license unless he has been employed about a steam boiler for a period of not less than 2 years prior to the date of the application. The examination for license shall be upon the following subjects: Construction and operation of steam boilers, steam engines and steam pumps, and also hydraulics, under such rules and regulations as may be adopted by the chief examiner, which rules and regulations and standard examination shall be used throughout the state. The license issued upon examination shall continue in force for one year from the date of issue.

Any engineer who has been employed continuously as a steam engineer under one employer for a period of 5 years shall be granted a special license for this plant upon payment of fees. This license may be renewed yearly and apply only to the position for which it is issued. Any engineer who holds a license issued under any ordinance of a municipal corporation of the state is entitled to a license without further examination upon payment of the fees. This license may be renewed yearly.

Appeals from the decision of a district examiner may be made to the chief examiner, who has power to decide the questions at issue.

All salaries and expenses of this department are to be paid upon order of the auditor of the state out of the funds of the state treasury arising from fees as provided by this law and in no case shall any of this compensation and expense be paid out of the general fund of the state treasury.

Some of the distinct features of this law are: All engineers employed in one place for 5 years shall be granted a license without examination; all engineers must be 21 years of age; no increase in taxation, as the law is self-supporting; all examinations are the same, making no graded license; examinations cover certain enumerated subjects; and a uniform standard of examination is maintained throughout the state.

Bill Proposed in New York

IN New York the bill referring to the licensing of stationary engineers and firemen was introduced as an amendment to the labor law. It makes it unlawful for any person other than a licensed engineer or fireman to have charge of a steam plant in the state except locomotive boilers and engines used for passenger and freight service on steam railroads, boilers and engines under the jurisdicion of the United States, boilers and engines used for heating where the pressure of steam does not exceed 10 lb. per square inch, boilers and engines used for agricultural purposes exclusively, and boilers and engines under the jurisdiction of the state of New York.

To facilitate the examination of engineers throughout the state and to provide for adequate protection of life and property the state may be divided into districts to be designated by the chief examiner. The chief examiner shall be appointed by the governor and shall hold office for a term of 6 years subject to removal at any time by the governor for sufficient cause. The chief examiner must have had not less than 10 years' experience as a competent stationary steam engineer prior to his appointment.

The district examiners, each of whom must have had not less than 7 years' experience as practical stationary engineers, shall be appointed by the chief examiner, such appointments to be made from lists to be prepared by the civil service commission and they shall hold office accordingly.

The chief examiner shall issue such instructions, make such rules and regulations for the government of the district examiners as shall secure uniformity of action and proceeding throughout the state. The salary of the chief examiner shall be $2500 per year, that of the district examiners $1800. The chief examiner shall give a bond in the sum of $2500.

Each applicant for an engineer's license must be a citizen of the United States or must have declared his intentions to become so, and shall have had not

less than 3 years' practical experience as an engineer or fireman or served as an apprentice for 3 years at engine, boiler or pump construction, and one year in boiler and engine room. A license granted shall continue in force for one year from the date of issue unless revoked for sufficient cause. This license may be renewed from year to year upon payment of fee without examination. The fees for license and examination shall be $3 and for renewal $2.

If an engineer shall be at the time of the passage of this law a holder of a local municipal license, the chief examiner may issue without examination, a stationary engineer's license evidenced by a certificate of the same grade as his local license, and such license may be renewed from year to year.

Any person may appeal from the ruling of the district examiner to the chief examiner. The chief examiner shall then instruct the district examiner to name 2 operating engineers and the appellant likewise to name 2 engineers and the 4 engineers thus named shall select a 5th engineer, all residents of the city or district. These 5 engineers constitute a jury, the decision of the majority of which shall be conclusive.

Licenses shall be granted to the following classes: Chief, unlimited. First class, any boiler or boilers and any engine not exceeding 150 hp. Second class, limited to a single boiler and any engine not exceeding 25 hp. Two years' experience as either second or first class engineer are necessary to make an applicant eligible for the next higher class. Third class, a special license may be granted by a district examiner to operate any particular plant and no other, provided, however, that before such license is granted the owner or operator of such plant shall make application to the district examiner by which it shall appear that the owner is unable to procure a duly licensed engineer and in such case the application may designate for a term of 30 days, but such special license shall not be renewed nor shall any district examiner again grant a special license for the same position within 30 days from the time the special license expires.

An exception is made in the case of a marine engineer holding a United States license who on presenting the license to an examiner of the state shall be given an examination and if found qualified shall be given a stationary engineer's license of the same relative grade as the United States license that the applicant holds.

An engineer who has been operating a plant for 3 consecutive years shall be granted a license for the grade required by such plant without examination.

Connecticut License Law Proposed

IN the bill introduced in the legislature of Connecticut it is made unlawful for any person not holding a license to have charge of or operate a steam boiler or engine of over 25 hp., except locomotive boilers used in trasportation, steam engines or boilers carrying less than 25 lb. pressure per square inch, or boilers used in private residences for heating purposes or steam boilers on engines used for agricultural purposes. The engineer must be upwards of 21 years of age, a citizen of the United States and hold a license of the class suitable for the plant he is in charge of.

The bill provides for the appointment of a chief examiner of engineers by the governor. He shall be a practical operating stationary engineer of at least 10 years' experience. The term of office of the chief examiner is 3 years and his salary is $1500 a year. In order to facilitate the examination of engineers throughout the state the chief examiner shall appoint a district examiner for each congressional district. The district examiners shall have had not less than 5 years' practical experience as operating stationary engineers and be citizens of their representative districts. The chief examiner shall give a bond in the sum of $3000 and district examiners shall each give a bond of $1000.

Any engineer who has, prior to the passage of this act, been in charge of the same plant for 3 or more years can secure a license without an examination.

On payment of $2 any person who shall satisfy the board of his competence to have charge of a steam plant may receive a license permitting him to operate the plant specified in his application for one year unless sooner revoked. This license shall apply only to the plant, boiler or engine for which it is issued and before taking charge of another plant the licensee shall apply for another license. For annual renewal of licenses, a fee of $1 shall be paid. The examiner may at any time revoke any license issued, for sufficient cause.

Any person dissatisfied with the official action of any district examiner may appeal to the chief examiner whose decision in the matter is final.

Changes in Massachusetts Law

IT would seem from the proposed amendments to the Massachusetts law that the manufacturing interests of the state had either become reconciled to the existing law for the inspection of boilers and licensing of engineers or had decided to let the engineers have their own way in this regard, as the amendments proposed are all from the engineer's point of view. These amendments do not change the spirit of the existing license law but it is evident that considerable difficulty has arisen which makes it advisable to change the wording in some parts. For instance, the words "have charge" and "in charge" are amended to designate the person under whose supervision a boiler or engine is operated. The words "operate," "operated," and "operating" designate the person who, under the supervision of the person in charge, operates the machinery of the plant.

The law as it stands requires that for third class engineer's license the applicant must have been employed as a steam engineer or fireman in charge of or operating boilers for not less than a year and a half or he must have used a first class fireman's license for not less than 1 year. The holder of this license is limited to an aggregate boiler capacity of 150 hp. and an engine not to exceed 50 hp. For second class engineer's license the applicant must have been in charge of a plant of over 50 hp. for not less than 2 years or held a third class engineer's license in a plant requiring such for not less than one year. This license entitles the holder to have charge of a plant no unit of which exceeds 150 hp. A first class engineer may have charge of and operate any steam plant, to be eligible he must have had charge of a steam plant or plants of over 150 hp. for not less than 3 years or must have held and used a second class engineer's license for not less than 1½ year. Once an engineer has secured a license in the proper manner it shall continue in force until it is revoked for incompetence or untrustworthiness.

A fourth class license entitles the holder to have charge of and operate hoisting and portable engines and boilers. A steam fire engineer's class license gives the holder the right to have charge of or to operate steam fire engines and boilers.

Firemen's licenses consist of extra first class to have charge of and operate any boiler or boilers. First class to have charge of and operate any boiler or boilers where the pressure carried does not exceed 25 lb., or to operate high-pressure boilers under the engineer

or fireman in direct charge thereof. Second class to operate any boiler under the engineer or fireman in direct charge.

Other bills brought before the legislature provide for regulation of the operation of engines and hoisting apparatus and extend the fourth class engineer's license to cover electric motors and engines operated by steam, gas, gasoline, compressed air and electricity, and for the inspection of boilers which have not been in use for a period of 6 months and over, before being again put into service.

Proposed License Law for Illinois

IN connection with its report to the state convention the committee on license law presented a bill, provisions of which are as follows:

Chief examiner shall be appointed by the governor for a term of 4 years and shall be a steam engineer of at least 10 years' practical experience immediately preceding his appointment. He would divide the state into 8 districts and appoint a district examiner for each district from a civil service list furnished by the civil service commission. Each district examiner must have at least 7 years' practical experience. The chief examiner shall be bonded for $3000 and each district examiner for $2000. The chief examiner is to have an office in the State House, with one or more clerks, as necessary, each clerk to be bonded for $1500. All employees of the license commission are to give their full time to the work.

Such rules as are necessary for carrying on the work are to be formulated by the chief examiner. The salary of the chief examiner to be $2400, each district examiner $1500, and of the clerk $1000. Boilers excepted from the provisions of the law are those carrying less than 15 lb. pressure and those under 15 horsepower, a horsepower being reckoned as 12 sq. ft. of heating surface.

Examination of engineers is to be of practical nature and uniform throughout the state. A license may be revoked at any time for negligence of duty, for the use of intoxicating liquor so as to impair the engineer's efficiency, or for insanity. The license may be renewed annually on application unless refused for cause, and renewal shall be granted without examination. Two dollars fee is charged, either for the original license or for renewal. Any person over 21 years of age who is a citizen or has declared his intention of becoming one may apply for examination. An engineer who has had 5 years' experience in charge of a plant and furnishes a certificate of his employer to that effect is to be granted license for that particular plant without examination and an engineer holding a license from a municipal examining board shall have state license granted without examination on payment of license fee.

An applicant dissatisfied with the decision of a district examiner may appeal to the chief examiner, whose decision shall be final. License must be displayed by each engineer holding one in the plant where he works, and $5 fine is provided for failure to do this. Ten dollars fine is provided for each engineer or owner who violates the provisions of the act.

Locomotive boilers and those under the jurisdiction of the United States are exempted from this provision. All fees are to be turned in by district examiners to the chief examiner by the 10th of each month and by the chief examiner to the state treasurer by the 15th.

The bill has been passed upon by lawyers and by members of the legislature and pronounced satisfactory from a legal and legislative point of view, and it is probable that it will be brought up before the next legislature.

Proposed Colorado Law

IN Colorado the proposition is to have an inspector of steam boilers who is an experienced engineer of not less than 10 years' actual experience, appointed by the governor, the term of office to be 2 years and the inspector to be bonded in the sum of $5000. He is to receive a salary of $3000 and mileage. Four deputy inspectors are to be appointed by the chief inspector, each to have had not less than 5 years' actual experience, to receive a salary of $1800 and mileage. A clerk may also be employed at a salary of $1000.

In regard to the license, the law is to apply to boilers of more than 5 hp. capacity except locomotives, automobiles and heating boilers in private houses. The boiler inspectors are to be the examiners for engineer's license. There are to be 3 classes, first class unlimited, second class limited to 100 hp. or less, and third class to 20 hp. or less, with special license for traction engines and portable engines and boilers. The fee for examination is $10 for first class, $5 for second class and $3 for third class or for traction engines. For first class the applicant must have had 3 years' experience, second class 2 years' experience, third class one year's experience as fireman under a competent engineer. Licenses are to be renewed without examination on the payment of $1 within 30 days from expiration of the old license, this renewal to be made each year. An applicant failing on an examination may not take another examination within 3 months of the first.

Appeal may be made from any subordinate examiner to the state inspector, whose decision is final. Two inspectors are to constitute the examining board at any examination, the times and places of examination to be determined by the state inspector in accordance with the needs of different localities. Cities where ordinances for licensing engineers are already in force are exempted from the operation of the state license law. This bill is now before the Colorado legislation for action.

Bill for Iowa

IN Iowa a bill got as far as the committee and provides as follows:

License must be procured for the operation of all boilers except low-pressure boilers of less than 75 sq. ft. heating surface carrying pressure not over 15 lb. The state is to be divided into 5 districts by the chief examiner. Applicants for the position of state examiner are to be examined by the professors of mechanical engineering, of electrical engineering and mining engineering in the Iowa State College, the examinations to cover construction and operation of steam boilers, steam engines and steam pumps. The applicant receiving the highest rating would be chief examiner, the next 4 in order would be the district examiners, the examiners to hold office until removed for cause. In case of vacancy in the office of chief, the district examiner having the highest rating is promoted to chief examiner, and the district examiner's office thus left vacant is filled by the next highest applicant on the Civil Service list. Each applicant must be a resident of Iowa with not less than 10 years' experience in practical steam engineering. The chief examiner is to receive a salary of $1800 a year, and district examiners $1200 each, with necessary traveling expenses, and the chief examiner is to have a clerk at a salary of $600 a year. The examiner is to be bonded for $3000, district examiners for $2000 and the clerk for $1500.

Applicants for license are to be examined on construction and operation of steam boilers, steam engines and steam pumps and also hydraulics, as may be specified by the chief examiner. For first grade license the applicant must have had 5 years' practical experience and to be entitled to take charge of plants of unlimited horsepower. Applicants for the second grade must have 3 years' experience and are privileged to have charge of plants not over 150 hp. For third grade, applicants must have 2 years' experience and can take charge of boilers and engines not to exceed 50 hp. Special license for traction and portable engines may be granted for such machinery by passing for third-class examination. Appeal from the district examiner may be made to the chief examiner if desired. The fee for first examination is $3 and the fee for the yearly renewal is $1. Penalty for violation of any of the provisions is a fine of not more than $100 or less than $10.

Amendments to Chicago's License Law

IN the City of Chicago provisions suggested for amending the present engineer's license law are that the mayor shall appoint a chief examiner at a salary of $2500 a year, with 2 other examiners at a salary of $2000 each, all to be taken from the Civil Service list. Each examiner must be at least 30 years of age with at least 10 years' practical experience immediately preceding his appointment and for the last 3 years of this experience must have carried a Chicago engineer's license.

A chief clerk is provided for, to receive $1500 a year, and 4 inspectors at $1350 a year each, all to be Civil Service appointees and each to have held a Chicago license for 2 years previous to appointment. The city police are instructed to visit all plants at least twice a year and report all violations to the board, all fines collected as a result of the police force to be put into the police pension funds. All applicants for license must be at least 21 years of age, with 2 years' practical experience in care and operation of boilers and engines. The provisions of the Chicago ordinance as it stands, are that the mayor is to appoint a board of examiners consisting of 3 practical engineers to have daily sessions between the hours of 9 and 10 o'clock for examining applicants.

The application for license must be accompanied by $2 in the case of an engineer or $1 for water tender's license. Applicant for engineer's license must have had 2 years' practice in management and operation of engines and boilers, and for boiler tender's license must have a thorough knowledge of construction and operation of boilers. The license is good for one year, must be renewed within 10 days of the expiration.

The only exemptions are locomotives and boilers carrying not more than 10 lb. steam pressure. The operation of a plant without license is punishable by a fine of not less than $20 nor more than $50 for the engineer and not less than $50 nor more than $200 for the plant owner.

New Jersey Bill Governing Municipal Licenses

IN New Jersey a bill was offered to authorize governing bodies of any of the cities of the state to provide for the examination and licensing of engineers and firemen, and to prevent the use and operation of steam apparatus except by a duly licensed engineer. It also gave the governing bodies the right to establish by ordinances, grades of licenses and specify the terms and conditions under which such licenses may be issued and renewed; to fix the fees to be charged, to provide for the revoking of licenses, and to appoint 3 engineers who have had at least 10 years' practical experience as stationary engineers to be called a board of licensing engineers, with such powers as may be deemed advisable, and to establish and enforce the rules and regulations for the examination and licensing of engineers, provided, however, that the board or body mentioned shall serve without compensation.

This law does not include under its jurisdiction steam boilers or engines operated by the government of the United States, railroad locomotives, road motor vehicles, fire departments of any city, those used for agricultural purposes exclusively, for heating purposes exclusively, or for heating purposes where the heating surface does not exceed 150 sq. ft. or carry a pressure of over 15 lb. To enforce this law a fine of not over $100 may be imposed.

Saskatchewan Law

IN Canada considerable activity has been noticed during the past year in regard to license laws, and the provinces of Ontario, Saskatchewan, Alberta, Quebec and Manitoba now have license laws regulating engineers. That in the province of Saskatchewan provides for the issuance of provincial, third class, second class and first class certificates, also permits. The provincial certificate is good for one year, authorizes the holder to operate boilers and engines up to 40 hp. capacity. It may be obtained by serving 12 months as fireman under a certified engineer and then passing an oral examination before the inspector of steam boilers, or by producing proof of at least a year's experience as engineer in charge of a boiler or engine, or 3 years' apprenticeship in a shop for the manufacture of engines and boilers, or by passing an oral examination to qualify for which an applicant must be able to show either 3 seasons' firing experience or experience as an engineer which can be accepted as equivalent to this. Diplomas from engineering schools or agricultural schools are not accepted unless with them the applicant can produce proof of the necessary firing or operating experience. Or the provincial certificate may be secured by producing operating certificates granted by some incorporated body authorized to issue them, which embraces certificates from other provinces or governments.

Third, second and first class certificates can only be granted on the result of a written examination, except in the case where the applicant produces a foreign certificate of a sufficiently high grade, together with satisfactory proof of his experience. The holder of a third class certificate may take full charge of boilers up to 50 hp. or act as assistant in the operation of a boiler up to 200 hp. The second class engineer may take full charge of boilers and engines up to 300 hp., and a first class engineer may take full charge and operate power plants of any capacity. Permits are good for 30 days only, and are granted only in cases of necessity where the owner of a boiler is unable to obtain services of a qualified engineer. All applicants for certificates should be able to furnish satisfactory proofs of sobriety and good conduct, and all certificates are subject to cancellation for carelessness, inefficiency, intemperance, etc. The fees charged for certificates of different grades are as follows: Provincial certificate first and second issue, $3; provincial certificates after second issue, $5; third and second class examinations and certificates, $5 each; first class examinations and certificates, $10; 30-day permit, $5.

THE LICENSE LAW

By Harry W. Benton

TO obtain a first class engineer's license, a man must produce satisfactory proof that he has had 10 years' experience in the operation of stationery steam boilers and steam machinery, and by examination he must show that his knowledge and experience is such that he is thoroughly qualified and competent to be entrusted to take charge of any type or size of stationary steam boiler, steam engine, or steam apparatus.

A second class engineer's license will be issued to a man who has had 5 years' experience (as set forth above), and who, by examination, shows that he is qualified and competent to be entrusted with the care and operation of stationary steam boilers, engines, etc., not to exceed 100 hp.

A third class engineer's license will be issued to a man who has had 2 years' experience (as set forth above), and who, by examination, shows that he is sufficiently acquainted with the duties of an engineer to be entrusted with the care and operation of stationary steam machinery not to exceed 20 hp.

These are taken from section 16 of a proposed license law for steam engineers in the State of Illinois; the proposed law is drawn by members of the N. A. S. E.

It is to be hoped that the Illinois engineers are successful in getting a good license law passed, if they can get these 3 clauses included, they will have made a good move in the right direction. In Ohio the engineers are at a disadvantage for just such terms in the law, and the Illinois law should guard against a condition such as exists here.

The writer is of the opinion that a national law instead of state laws, would be a vast improvement over the present methods, provided that in changing to such a law all men would be licensed upon a fair basis so that the license a man would receive, would be a fair representation of that man's ability as an engineer.

A man licensed as first class ought to be a better engineer than a man licensed as third class; but in Ohio the reverse is very often the case.

For instance, if you take a trip to several of the factories and ask for employment, stating that you have a first class license, you will, in the majority of cases, be told, "We don't go by the license; we have had men who had only a third class license, but who gave us better service from our plant than some men we have had who had first class license."

Among the engineers with whom I am acquainted, I know 2 men who work in the same mill. One man always did have a first class license, never had a lower grade, and came off a locomotive a few years ago; he has run locomotives for years, so he says. Now I know positively that this man can not set the valves or eccentric of a single eccentric Corliss engine; he knows less about the adjustment of any type of high speed or medium speed engine. I doubt if he could set the valves of a duplex pump or even set an ordinary plain slide valve. He knows a shaft governor from a flyball governor, but he could not tell the difference between 2 types of shaft governors; both would be shaft governors; that is all as far as he knows. He could not explain kinetic energy, inertia, centripetal or centrifugal force, latent heat, etc. He knows an indicator diagram when he sees one, and can tell a good one from a poor one, but he could not tell what type of engine a diagram was taken from. He cannot read a diagram, much less adjust any type of valve gear.

This man can start and stop an engine, oil it and feel the bearings and wipe it in spots once or twice a week, and, generally speaking, he is considered a fair engineer; but is he? He is an engine runner, or operator; but as far from being a first class engineer as the equator is from the poles. He has a first class license; always did have; but does he deserve it; could he get one on a fair examination. I know positively that if he went before the examiner now he would have to be favored to get a third class.

The other man has been before the examiner twice, and has now got a second class license. By comparison this man is just as good an operator as the first man; he has a better knowledge of the various types of valve gears, and can adjust several of them; he can set a slide valve, a duplex pump valve, can figure the capacity of a pump, the horsepower of an engine, the safe working pressure of a boiler shell, the size of safety valve for a given boiler, etc., and the first class license man can do none of these. Now, which man ought to have the first class license? Well, that is what we encounter in Ohio, and our Illinois brothers will do well to keep clear of such an objectionable condition.

The cause of this condition in Ohio is what may take place in Illinois, i. e., a change from city license to state license. It seems that when the city license law first went into effect, a license could be obtained by having some engineers sign an affidavit stating that they knew the applicant to be competent, reliable, etc. (whether they did or not), and that when this was done the license was made out; and that in some cases the applicant himself did not even see the examiner, and they would not even know one another if they met on the street.

Later on comes the state license law, and only one grade of license issued, which, of course, was first class; as these city licenses expired they were "renewed," I should say "exchanged," by the state examiner for a first class state license, and this has continued until the present time. Any applicant who passed the examination at that time, of course, got a first class license, thus all licenses were of the same grade. Next (by what now appears to have been simply an order from the chief examiner), the department issued first, second and third class licenses, according to the amount of experience and knowledge a man had as shown by his examination.

This is as it should be, but it is not law in the State of Ohio. In April, 1909, all licenses issued before May, 1902, whether by renewal or otherwise, were cancelled and the holders had to be re-examined at once, because the law as it stood prior to May, 1902, had been declared unconstitutional.

I believe all of those that were so re-examined were holders of first class licenses, whether, however, that statement is strictly true or not I can not state, but I do know that the men who had been examined after 1902 and had been given either second or third class licenses were glad of the cancelling of those old fake firsts, and hope that thereafter every man's license would be an evidence of his actual ability.

Such was not the result. The old licenses in most cases were exchanged for new ones of the same grade, only in a small per cent of the cases was the grade lowered. Every man was examined, in nearly all cases, by word of mouth only. I know several men who did not write a word, and 2 of them in particular, when

they came back, told a fine story of how the examiner said, "You did fine, made 98⅞ per cent," and brought back a first class license. One of these men told me himself that from the time he entered the examiner's office and was examined (after waiting his turn), told his percentage and given his new license and out on the street again, was 30 minutes.

It has always been the opinion of the writer that all experience or all education should never be allowed to get a first class license. A man must have some experience before he should be granted a third class license. Two or three years' experience on a third class license would entitle him to be examined for a second class license. If he showed he had sufficient knowledge he should be raised to second class. This makes second class men have 4 to 5 years' experience. Three years' experience as second class should allow them to try for a first class license, and they should not be allowed a first class license unless they thoroughly understand a steam power plant and its accessories from the coal pile to the engine flywheel. The standard for first class license should be kept high. By this plan, no matter how well educated a man might be, he could not "walk over" the old heads; he would be compelled to serve 7 or 8 years before he could get classed as first class. On the other hand, a man with 40 years' experience could not get first class unless he studied and acquired education necessary to be a first class engineer. To be a thoroughly successful first class engineer, a man must have knowledge and experience, and he should be forced to acquire both before he could be classed as first class, or else stay at second class.

A plan of this kind would tend to raise the quality of engineers and would make a license do its duty—represent the ability of the holder.

In justice to the Ohio law as it is applied now, I must state that to get a first class license an applicant has to meet the conditions outlined herewith, but the standard ought to be higher. The trouble yet is in the fact that this host of old license holders are holding the best grade licenses and that they have never faced the test. By some means they should be brought to face the examiner the same as the later applicants have.

INJUSTICE OF EXAMINATION FOR LICENSE

By John J. Nash

LICENSE examinations have a tendency more and more to encroach on the personal rights of engineers; this is particularly true in regard to examinations which have to do only with the ability or efficiency of the applicant.

Attention of the engineer is called to the fact that his efficiency or ability has nothing to do with license laws and license laws have nothing to do with his efficiency or ability. This is a matter that concerns only his employer and himself. The public is not interested in this.

The tendency is to lose sight of the fact that the examining board should be working in the interest of the public, and assume that it should be working in the interest of the employer and the engineer. This opinion is so well grounded by the cry from engineers organizations, engineering magazines, etc., that the examining boards have come to feel a certain responsibility to the employer, not only for the safety of the applicant, but for his stability, ability and efficiency as well.

The result of this condition is shown in the examination, which begins by questioning the applicant on the construction and operation of steam boilers plus catch questions; after which the examiners proceed with the remaining 9/10 of the examination to delve into the ability and efficiency of the applicant. This was not intended by the legislature. It is not in the power of that body to establish an employment agency to secure efficient workers for private employers.

The only legal excuse for an engineers' license law is public safety. No matter what your opinion has been on this matter, public safety is the only reason that can be advanced for an engineers' license law.

In presenting an engineer with a license certificate, the state, in effect, says to the employer: "We will permit you to put this man in charge of your steam boilers; we will take the risk with him." To assume that the state guarantees the ability or efficiency or even a degree of safety in the employment of the person licensed is a mistake. It guarantees nothing in this case. It merely takes this means to prevent, as far as possible, accidents which might occur through ignorance and avarice.

The preponderance of opinion among the operators seems to be that this line of examination is desirable from a purely selfish, though not legal, standpoint; that is, he thinks that this part of the examination will exclude men of less ability than he and that he is then in a position to profit indirectly by the license law. He is deluded who thinks thus.

Usually the Massachusetts law is referred to as approaching the engineer's ideal in a license law, though some are wishing for a federal law, not knowing that the constitution does not permit it. If the Massachusetts law is desirable and is of real benefit to the operator, I ask those advocates of such illegal, though desirable, laws to point out to us some material tangible benefit that they have derived from this encroachment of their personal rights.

It is the writer's unbiased opinion that the engineers of Massachusetts are receiving a less average wage than the engineers of Connecticut. They are working under less favorable conditions. These opinions are based on a number of specific cases.

Living only a few miles from the Massachusetts state line, the writer as yet has not seen enough merit in their law to make him wish to dwell under their leaden umbrella.

The questions answered by P. E. Merriam in the April issue induced me to write the foregoing.

Since engineers' license laws are necessary only as a precaution, or as a measure of protection from the menace of boiler explosions, and since there is no other excuse for their existence, I beg to state that the questions answered by Mr. Merriam are irrelevant. They have no bearing on the point the public is interested in; therefore, they have no proper place in examination.

Some of those who are yet deluded and inclined to enthuse over that phase of the examination which I object to, will advance the argument that it tends to make better engineers. From the operator's standpoint, I am not sure that this is desirable. Mark Twain says, "We should be thankful for the fools."

What has brought out the latent qualities of the engineers in the no-license states? Was it not the necessity presented by the development of modern machinery? Are you prepared to say that he is still waiting for the license law to develop him?

The writer submits the following questions as proper questions to be asked an applicant for an engineer's license. They should be asked in various ways not to find out if he could answer them, but to find out if he knew and fully realized the consequences in case of ignorance or neglect on his part. There should also be included questions on refrigerating machines, pressure tanks, etc., in the examination, but all questions would have a direct bearing on the safety of operation, not design. The state should not examine the operator on design. It should see that the plant is safely designed, installed and equipped before it is operated; then it may properly see that the operator has sufficient knowledge and experience to safely operate the outfit. The plant on which an engineer is employed is the only one he should be licensed to operate, except those that he has already operated. An operator is or is not safe. How he can be third class safe, second class safe, etc.? If one looks closely into this "classifying" he will find that it infringes on our personal rights.

It is an injustice to the employer to examine the applicant on his ability, efficiency or any other subject except safety, since it has the effect of reducing the number of applicants for him to select from. This, of course, is an injustice to the employer as well as the employee and is not what was intended by the law-making bodies.

If the engineers and the examining boards didn't assure that the license laws were enacted and a board appointed for the purpose of acting as an employment agency with the right to exclude from the field of operating engineers any applicant, there would be less objection to the movement.

Questions That Should be Asked

WHAT is understood by the term 100 lb. gage? What is a square inch?

What pressure in pounds tends to rend asunder from end to end a boiler 18 ft. by 72 in. at 100 lb. gage?

Name the accessories necessary on a steam boiler for its safe operation.

For what purposes are water columns, gage glasses and gage cocks used? What care should they be given to keep them in safe working condition?

Why is it necessary to have a pressure gage attached to a steam boiler? What care should it be given? How should it be attached? Name the fittings between gage and boiler. Should there be more than one gage on a boiler?

What is the safety valve intended for? On what principle does it depend for operation?

What care should it be given? Should there be more than one safety valve on a boiler? Should there be a valve between the boiler and the safety valve?

What methods are used to get water into a boiler under pressure? How is the injector put in operation? How is the boiler feed pump put in operation? How stopped? Should the feed pump be run at a good speed to fill the boiler and then stopped? What valves, if any, should be between the feed pump and boiler?

How should these valves be set? When starting the feed pump, is there any special precaution to be taken?

What is the blow-off pipe intended for?

Is there any special care to be given to the blow-off pipe? How often should the blow-off valve be opened?

What bearing has scale or oil in a boiler on the safety of its operation?

What precaution should be taken in installing steam pipes? Would the complete rupture of a large pipe be more disastrous than that of a small one? In what proportion?

What is the governor on an engine for? On what principle does the throttle governor depend for its operation? On what principle does the flywheel governor depend? Do you know of any scheme or device in use to prevent an engine from exceeding the speed it is intended to run at in case the governor should fail? Is it necessary to use a safety stop with every type of governor? If the governor belt should break, how should the stop operate? If the speed is exceeded and the belt does not break, how is the safety stop intended to operate? If a spring should break on a shaft governor, what way would it effect the speed of the engine?

What would be the probable result if the main belt broke, or the circuit breaker came out and the governor failed to operate at the same time with no safety stop? Why?

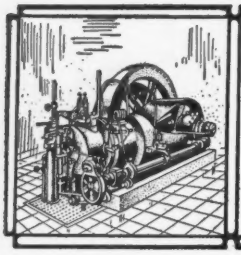
If a direct heating system, designed for 5 lb. back pressure on the engine failed to heat sufficiently on a very cold day, what would you do?

Contrast the foregoing questions with those in the April issue, page 302 Ohio, and page 304 New Bedford, Mass. The second and fourth questions on page 302 have no bearing on the safety of anyone; therefore they are irrelevant. It is an imposition and a direct encroachment of the personal rights of the applicant to ask them. It is also an attempt to allow but a favored few to approach the employer. The first and third of these belong in that class of questions that might serve to get an idea of the applicant's general knowledge, but something with more bearing on safety would be better.

Not one of those questions on page 304, April issue, should have been asked the applicant, because they concern only the applicant and his employer. The examiner was trying to find out if the applicant had a working knowledge of the indicator which is used entirely to detect losses through faulty valve setting, leaky pistons, etc. This was clearly not a question of safety; it was an assumption on the part of the examiner that he was empowered to look after the employer's interest. It was clearly an encroachment of the personal rights of employer and employee. And it is about time we engineers and employers took some means to stop this infringement of our personal rights.

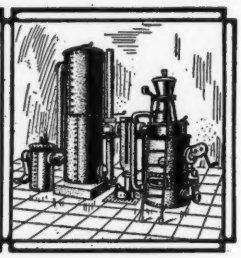
A COAL ANALYSIS THAT PAID 8000 PER CENT

THAT the purchase of coal on specifications needs to be followed up with analyses of the deliveries has been amusingly demonstrated by the recent experience of a Massachusetts city. The school board of this city has for some time been buying coal for the school houses on specification, but only recently did it take any steps to see whether it was actually getting the quality it was paying for. Lately it has made the first analysis of the coal delivered to it, and discovered that the coal was below the stipulated quality. As a result of this analysis, costing $10, the coal dealer has paid to the city a rebate of $873.01 on the payments for coal.



Gas Power Apparatus

Producers, Engines and Industrial Applications



POINTS FROM EXPERIENCE

LEARNED IN EVERDAY HANDLING OF GAS ENGINES

DISCUSSION at the Pittsburg meeting of the American Society of Mechanical Engineers on Gas Engines brought out much of interest from those in direct charge of plants, abstract of the chief points of interest being as given below.

A. E. Maccoun was the first speaker, and called attention to the high initial pressure, as much as 334 lb. needed in large gas engines for blast furnace gas in order to get as low as 65.4 lb. m. e. p.; also to the advantage of a continuous burning process in reducing this.

With large gas engines, for instance, an engine with a cylinder 48 in. diameter, it becomes difficult to design the working parts, such as cylinders, piston

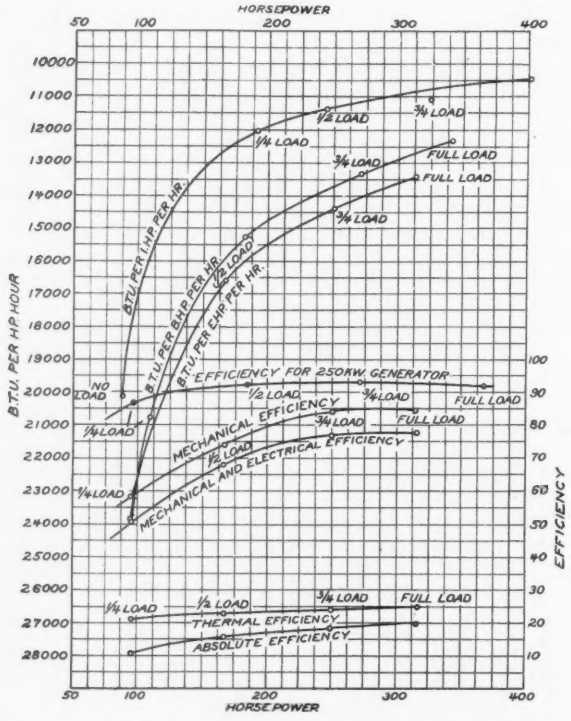


FIG. 1. RESULT OF TESTS ON WESTINGHOUSE GAS ENGINE 21¾ BY 30 IN. ON BLAST FURNACE GAS

rods, pistons, frames, crank pins, etc., large and strong enough, and to find material good enough to stand the enormous strains to which they are subjected.

This causes fatigue on account of the high temperature and pressure conditions, and many cracked pistons, rods, heads and cylinders have resulted, and there is no doubt but that much of the economy gained in the use of fuel has been lost in the enormous repairs required on many of these engines.

With smaller gas engines many of these troubles are not met with, and those that are encountered are not of very great importance, but in designing large engines, where the pressure on crank pins, etc., is nearly 1,000,000 lb., which is suddenly applied by an explosion, this is of the greatest importance, and I have no doubt that in time a different cycle for burning the gases will be developed, so that these conditions will be modified.

So far as reliability is concerned—although they may require more skilled supervision—excellent results are being obtained at many plants. At Edgar Thomson Furnaces, of the Carnegie Steel Company,

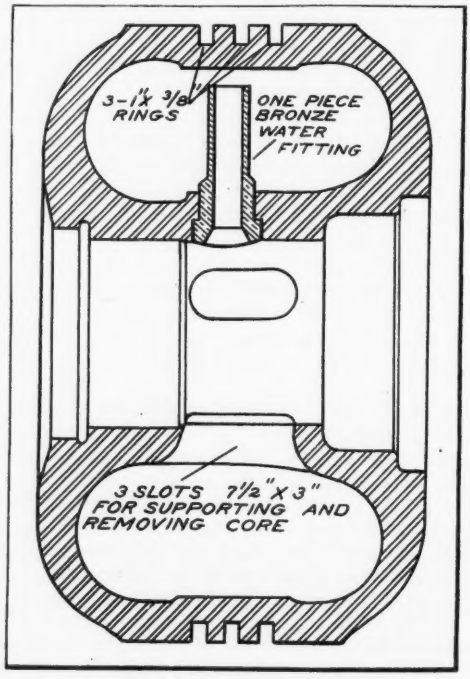


FIG. 3. SECTION OF CAST STEEL PISTON

during 1910, the record of operation was as follows: No. 1 blower, horizontal, twin tandem, Westinghouse, 38 by 54 in., in operation, 90.3 per cent of the time for a year; No. 2 blower, horizontal, twin tandem, Westinghouse 38 by 54 in., 90.0 per cent; No. 1 electric, horizontal, twin tandem, Westinghouse, cylinders 40 by 54 in., 75.87 per cent.

Experimental Gas Engine

THE Carnegie Steel Co. had a small tandem gas engine, cylinders built 21¾ in. diameter and 30 in. stroke, coupled directly to a 250-hp. d. c. generator. It was run continuously under all kinds of conditions and numerous tests were made on it. The curves, Fig. 1, give a summary of one test.

Important factors in a gas engine installation are the first cost of the unit and to have a machine on which the repair cost will compare favorably with a steam unit of the same capacity. The latter is, of course, by far the most important consideration. A fair excess in first cost would be allowable, if the upkeep would not be excessive.

the cylinder from the engine. Both cast-iron and cast-steel bushings have given satisfaction.

A space as large as possible should be allowed for circulating water, and special attention should be given to the bushings connecting the inner and outer walls of cylinders for igniters, air valves, etc., so they will remain tight and allow for the difference in expansion between the inner and outer walls of cylinders. Figure 2 shows the design of a cast-steel cylinder we have had in use for 2 years.

The limit of size of gas engine cylinders is very uncertain, but it looks as if 44 in. diameter should be about the limit until further results are obtained from the numerous designs now being tried out.

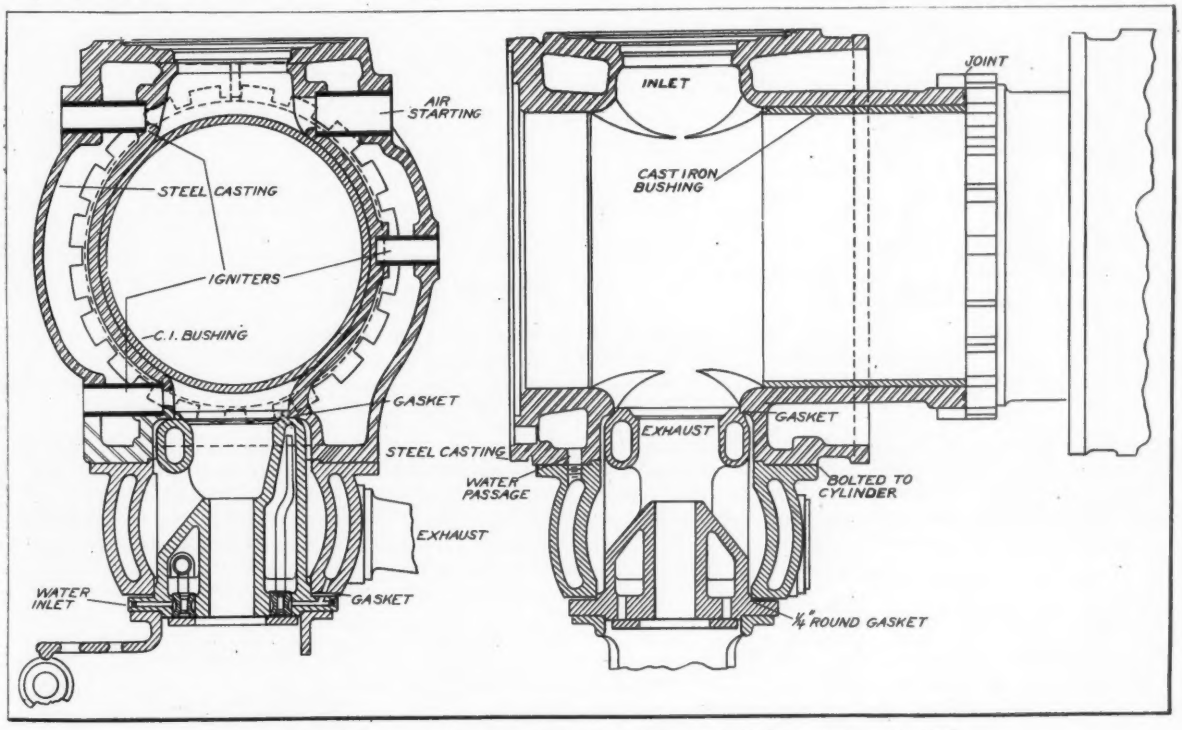


FIG. 2. SECTIONAL VIEWS OF REDESIGNED ENGINE CYLINDER WITH BUSHING

A number of sketches are given which show some of the improvements that have been made.

Cylinder Design

THE most important part of a gas engine requiring attention is the cylinder, the greatest difficulty encountered being the liability of the cylinder to crack and thus allow water to leak in, which seriously interferes with their successful operation. To prevent this, great care must be exercised to provide for the extreme temperature and pressure conditions, and to water-jacket carefully to prevent unequal expansion.

I greatly prefer the steel casting to iron, on account of its increased strength, together with its thinner walls; thus permitting the cooling to penetrate closer into the cylinder walls, reducing the temperature of the walls and also helping to prevent the fatigue of the metal.

Large gas engine cylinder castings should be made as plain and simple as possible, and preferably in halves and bushed. The bushing renders a new cylinder wall available at a cost much less than boring and fitting new pistons, from time to time. The bushing should be easily removable without removal of

Gas Engine Pistons

DESIGN of the piston is also of great importance, but it can now be relied on for any size to which the cylinder can be carried. Nearly all the builders are using cast steel for pistons of any size. They should be made in one piece and should be free from all parts that may come loose.

Figure 3 shows the type of piston at present in use, which is made from cast steel, and we have never had any trouble from this type of piston. It can be seen that it approaches a sphere, as nearly as is possible, which design gives enormous strength and also allows for expansion.

In the number of rings used in gas engine pistons, they vary from 3 to 8, and from snap rings to the more elaborate sectional rings with keepers. We prefer not to exceed 4 rings, of the latter type, with good depth and wearing surfaces. The rings should not be doweled in place so that the dowels can come out and cut the cylinders.

It is important that the pistons should never bear on the working bore of the cylinder; all this weight should be carried by the rod on the crossheads and

slippers, and nothing but the pressure due to the rings should be on the cylinder walls.

Piston Rods

IT is a most difficult problem to design a piston rod strong enough to stand the constant stresses and strains it is subjected to on a large size gas engine. The maximum stress on a section of rod, due to the explosion pressure, in pounds per square inch, varies from about 600 lb. to 11,000 lb. on the various American types of large gas engines, and still many of these rods have failed; it is nearly impossible to increase their size to any great extent, as some at present are as large as 13-in. diameter, but changes have been made in the design and material that have helped to strengthen them to some extent.

The material that our rods were first made of was nickel steel, as this was thought to be the best material to use, but we found this unreliable for this particular class of work and numerous failures developed. We find open hearth steel, of the following composition, more satisfactory: Carbon, 0.45 to 0.60 per cent; manganese, 0.45 to 0.60 per cent; phosphorus, under 0.04 per cent; sulphur, under 0.04 per cent; silicon, 0.10 to 0.20 per cent; to be heat treated to get: 50,000 lb. per sq. in. elastic limit; 95,000 lb. per sq. in., ultimate strength; 12 per cent elongation in 2 in.

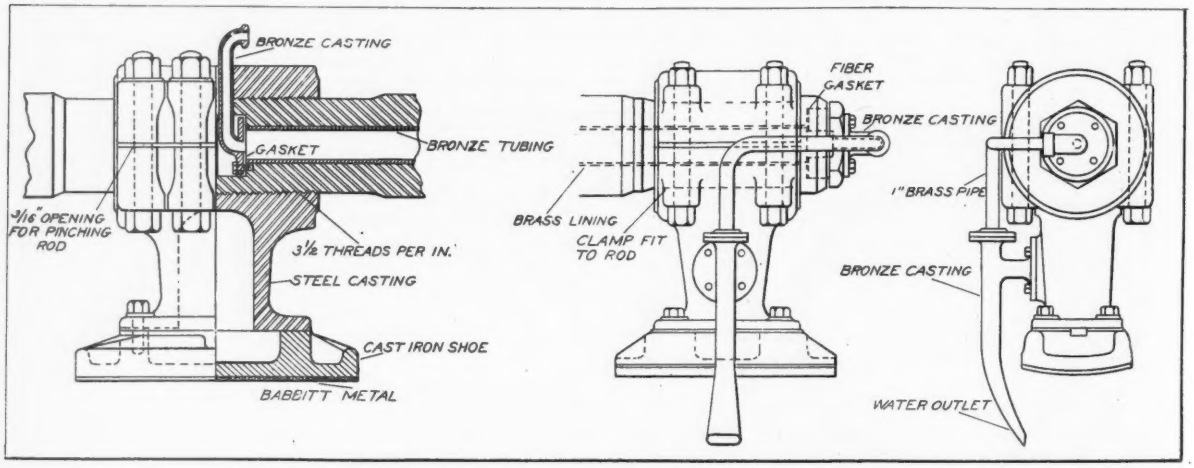


FIG. 4. DETAILS OF PISTON ROD AND CROSSHEAD

No trouble has been experienced by the wearing of piston rods made from this material, on account of their softness.

At the Edgar Thomson Works we were compelled to line the inside of all our piston rods with brass tubing, on account of the acid in our river water, and we have had excellent results from this practice. In fact, nothing but cast iron, cast steel or brass should come in contact with Monongahela River water, as it frequently runs very high in acid.

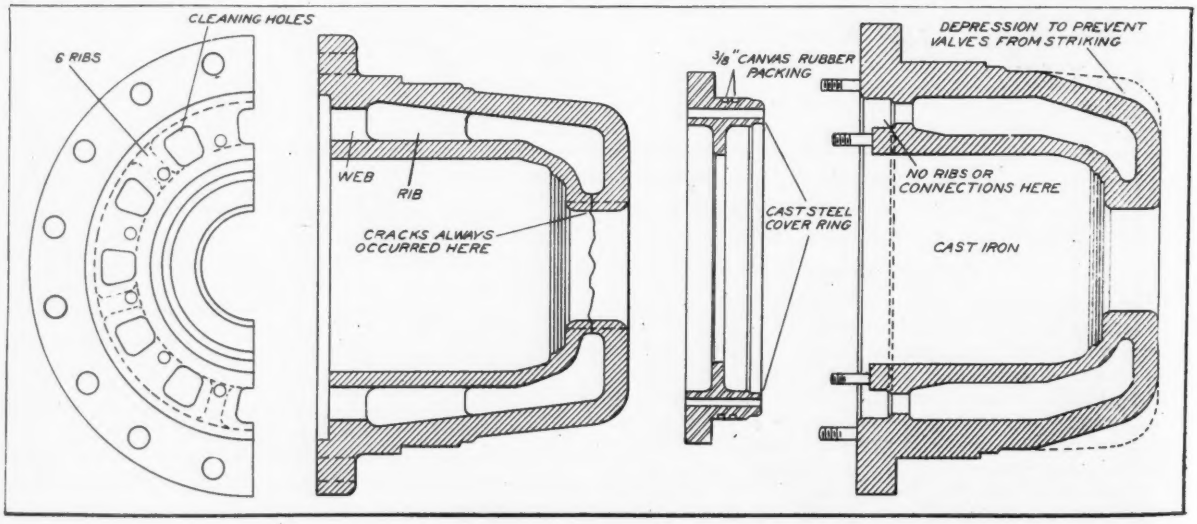


FIG. 5. CONSTRUCTION OF CYLINDER HEADS

There are 2 general methods of fastening the rods to the crossheads; by keys through rod, and by thread and nut, or clamp over the threads. Both keys and nuts have given considerable trouble, and it is hard to say which is the better type to use. The clamp over a thread, or other recess, seems to be preferable, as it does not interfere with the passage of the water from the end of the rod.

We were compelled to abandon all holes for the entry or outlet of water through the walls of piston rods, as these holes through the sides were found to

be very convenient places for cracks to start, and the water is now brought into and taken out of the ends of the piston rods.

Figure 4 shows detail construction of the rods and connections at present in use, which seem to be satisfactory.

Piston Rod Packing

VERY little trouble has been experienced from piston rod packing. The most important points to be watched are the fire rings; they should be solid and of sufficient number to reduce the explosion pressure before it reaches the packing rings, and care should be taken to have a sufficient number of packing rings to prevent trouble, as the increased length of stuffing box is very small compared with the trouble that will certainly occur, if the number of rings is reduced.

It is necessary to have sufficient side clearance so the rings can float, 0.005 in. is a fair allowance. The rings should also be fairly deep to allow wear. From present indications, our piston rod packing should last a good many years.

Cylinder Heads

AT first we experienced some trouble from cylinder heads, but by changing the design we found it possible to make perfectly satisfactory cylinder heads from cast iron.

Figure 5 shows the construction of the cylinder heads in our Westinghouse engines.

Inlet Valve Gear

MANY improvements can still be made on the inlet valve gears of all blast furnace gas engines. The essentials are as follows: 1. A reasonable percentage of dirt in the gas should not affect their operation. 2. Wear on all parts, cams, valves, seats, etc., should be easily compensated for in their method of adjustment. 3. Ample surfaces should be allowed for all wearing parts, to prevent wear and distortion of the valve setting. 4. Adjustment of each valve on the engine should be made so as to be independent of the others. 5. Valve gear should be arranged so that the relative ratio of the air and gas ports can be changed either individually or collectively and very quickly to suit sudden changes in the composition of the gas.

Many of the gears in use fulfil nearly all of these conditions, but none of them, so far as I am aware, fulfil the last satisfactorily, which is a most important one. By fulfilling this condition, many of the experiences from backfiring—due to the sudden changes in the quality of blast furnace gas—would be avoided.

COST IN GAS ENGINE PLANTS

RELIABLE DATA FROM ACTUAL OPERATING RECORDS

IN investigating this subject the committee of the American Society of Mechanical Engineers found difficulty in securing the cooperation of plant owners.

From a few records, however, data have been secured which are worth presenting in considerable detail. For obvious reasons, the plants are designated by letter.

It should be distinctly understood that the cost figures are presented as they are furnished by the operators, without attempt at verification.

Details of Plant A

THERE are 2 250-hp. pressure producers, 7 ft. inside diameter, with water seal bottoms and 9-in. firebrick linings, also 2 wet scrubbers, 7 ft. 6 in. in diameter by 18 ft. high, filled with wooden lattice work. There are 2 dry scrubbers, 7 ft. square by 3 ft. 6 in. high, filled with coarse shavings.

There is a 500-hp. horizontal, double-acting, 4-stroke-cycle engine with 2 cylinders, 23.5 by 33 in. arranged tandem. The engine has 3 bearings rigidly in line; runs at 150 r. p. m. and is direct connected to an electric generator. It is started by compressed air at 100 lb. pressure and has an electric ignition of the make and break type, the source of supply being a 110-volt d. c. lighting circuit and a motor generator set.

Two tar extractors and 1 blower, are used as auxiliaries.

Operation

THE data received covered 2 complete months. The plant is run 24 hr. a day from 6 o'clock Monday morning until 12 o'clock Saturday night, and the current generated is utilized for light and power. During the 2 months, a total of 308,410 kw. hr. were generated and 35,190 kw. hr. were used in the plant, leaving a net output of 273,220 kw. hr. The fuel used is bituminous coal. The cooling water from the engine is utilized for other purposes and is not, therefore, charged to the plant. The cooling and cleaning water for the scrubbers is not given.

Costs

FUEL cost 0.2576c per net kw. hr.; oil, 0.0141c; waste, etc., 0.0024c; a total of 0.0165c for supplies; labor cost for producer room, 0.1585c per net kw. hr.; for engine room, 0.0555c; for electrical machinery, 0.00000; or a total for labor of 0.214c. Repairs to the producer cost 0.0127c per net kw. hr.; to engines, 0.0040c; to electrical machinery, 0.000c; or a total of 0.0167c for repairs; making an entire total cost of 0.5048c per net kw. hr.

Details of Plant B

ONE set of producers of the Loomis-Pettibone type furnished for a 500-hp. horizontal, double-acting, 4-stroke-cycle engine with 2 cylinders, 23½ by 33 in. arranged tandem. The engine has 2 bearings rigidly in line, runs at 150 r. p. m. and is direct connected to an electric generator. It is started by compressed air at 240 lb. pressure, and has electric ignition of the make and break type, the source of supply being a 110-volt lighting circuit.

Operation and Cost

DATA received is for 15 complete months, the plant being run 10 hr. a day.

Costs as given below are in each case per net kw. hr.

Fuel, 0.4460c; water 0.0879c; supplies, (oil 0.0465c, waste, etc., 0.0335c), a total of .0800c.; labor (producer room, 0.1603c, engine room 0.2050c, electrical 0.000c), a total of .3653c; repairs (producer 0.0243c, engines 0.2375c, electrical 0.0000c), a total of 0.2618c; making the total cost 1.2410c.

Details of Plant C

TWO sets of producers of the Loomis-Pettibone type each of 2000 hp. capacity supply 2 1500-hp. horizontal, double-acting, 4-stroke-cycle engines each with 4 cylinders, 32 by 42 in. arranged twin tandem. Each engine has 2 bearings rigidly in line, runs at 107 r. p. m. and is direct connected to electric generator. They are started by compressed air and have an electric ignition of the make and break type, the source of supply being a motor-generator set supplying current at 60 volts.

Costs for 1908

ALL figures as before are for cents per net kw. hr. Fuel, 0.566c; supplies, oil and waste 0.044c; miscellaneous 0.013c, or total for supplies 0.057c; superintendence 0.031c; labor in producer room and engine room 0.173c; repairs to producer, 0.006c, to engine 0.000c, to electrical machinery .004c, or a total for labor of 0.010c; making a total cost of 0.837c.

Costs for 1909

FUEL, 0.439c; water .000c; supplies (oil and waste, .029c; miscellaneous, 0.016c.), a total of 0.045c; superintendence, 0.023c; labor (in producer room, 0.109c; engine room, 0.066c), a total of 0.175c; repairs (producer, 0.020c; engine, 0.006c; electrical, 0.002c); a total of 0.028c; making a total cost of 0.710c.

Costs for 1910

FUEL, 0.422c; water, 0.003c; supplies (oil and waste, 0.024c; miscellaneous, 0.015c); a total of 0.039c; superintendence, 0.026c; labor (producer room, 0.102c; engine room, 0.063c); a total of 0.165c; repairs (producer, 0.024c; engine, 0.004c; electrical, 0.005c); a total of 0.033c; making a total cost of 0.688c.

Details of Plant D

THERE are 2 400-hp. pressure producers, 8 ft. inside diameter with water seal bottom and with 9-inch fire-brick linings, and 2 wet scrubbers, 8 ft. in diameter by 20 ft. high, filled with coke. There are 2 dry scrubbers, 6 ft. square by 3 ft. 6 in. high.

Three 250-hp. gas engines, are vertical, single-acting, 4-stroke-cycle each with 3 cylinders, 20 by 19 in. arranged side by side. Each engine has 5 bearings rigidly in line, runs at 230 r. p. m. and is direct connected to an electric generator. They are started by compressed air at 200 lb. pressure and have an electric ignition of the make and break type, the sources of supply being a primary battery and a direct-driven magneto.

Details and Costs of Operation

DATA received is for 3 complete months, the plant being in operation 1439 hr. during the time and generating a total of 309,300 kw. hr. The fuel used was No. 1 anthracite buckwheat.

Fuel cost per net kw. hr. was 0.2828c; water, 0; supplies, total, 0.0572c; labor (producer room, 0.1135c; engine room, 0.2640c; electrical, 0.); a total of 0.3775c; repairs (producer, 0.0249c; engines, 0.1496c; electrical 0), a total of 0.1745c; making the total cost 0.8920c.

Resume

COAL at the plants given cost $2.55 a ton at Plant A; $4.53 per ton at Plant B, unknown at Plant C and $2.33 per ton at Plant D. Reducing the cost of coal at Plant B to $2.50 per ton to make it comparable with the others, the costs of operation compare as follows: Plant A, 0.505c, per kw. hr.; Plant B, 1.041c; Plant C, 0.745c; Plant D, 0.892c; giving an average of 0.796c as the operating cost which makes no allowance for overhead expense, interest, taxes, depreciation, etc.

ENGINES FOR AIR SHIPS

PARTLY historical and partly descriptive is the paper of E. W. Roberts on this subject, read before the National Gas and Gasoline Engine Trades Association, which contained data of interest as showing what can be accomplished in the way of a high power engine of small weight. Mr. Roberts referred to the Maxim Engine which was used on the first machine to make mechanical flight.

These were steam engines of compound type, 5 and 8 by 12-in. cylinders, delivering about 160 hp. each at 350 lb. steam pressure, and each weighing 320 lb., or about 2 lb. per horsepower. The walls of the cylinders were but 3-64-in. thick, and the engine ran at 350 r. p. m., giving a thrust of 2400 lb. on the propellers which were 17 ft. 8 in. in diameter by 16 ft. thick. This draft is something remarkable even among the performances of present day aeroplanes. The plant was supplied by a Thornycroft type of boiler, heated by gasoline, the gasoline being first heated in a small boiler to a vapor pressure of 40 lb. and then carried to the burner where it was mixed with air to get a Bunsen burner effect, on the injector principle. The solid blue flame in the fire box was 22 in. high.

As compared with this steam machine, Mr. Roberts showed that in present practice, of the 32 American makes, 12 are air cooled and 22 water cooled internal combustion motors, ten of these being of the 2-cycle type and 22 of the 4-stroke cycle. Seven of these motors are made with revolving cylinders, the average weight per horsepower, including radiators, lubricators and water to fill both the radiator and the jackets of the motor, is 5.88 lb. for the 4-cycle, and 3.75 lb. for the 2-cycle. For air cooled motors the average weight per horsepower is 3.19 lb.

As against this for the German makes of motors, the weight for water cooled without radiator, water or tank is 4.8 lb. per horsepower and for air cooled 4.15. The lightest motor made is a Gnome weighing 2.2 lb. per horsepower for a 100-hp. engine with 4 steam cylinders.

As to the reliability and continuous running of these engines, Mr. Roberts says that there are comparatively few of them that can be depended upon for more than one hour continuous operation. He rightly comments on this by saying: "It would be a nice condition of affairs if a marine or automobile motor had to be pulled to pieces for examination or adjustment at the end of a run of an hour's duration, or if the engine was so constituted that it would run hot and stick in that time or less." He states the causes of this difficulty as "chiefly insufficient water jackets, inadequate bearings, faulty lubrication, ports and valves too small for the high speed, poor balancing, small factors of safety and—among other evils, entire absence of locking devices for nuts and screw bolts. He states that these faults may be easily overcome by careful choice of material of great strength in proportion to its weight and by the use of shapes of great stiffness for the amount of material which they contain together with the elimination of every ounce of material that would serve no purpose.

It is evident from the records of the various flights that have been made that some builders of engines have paid attention to these points.

ENTHUSIASM IS AN explanation of what happens when the Brain and Heart meet and explode at white heat.—System.

WHEN THE TROUBLE MAN DID A QUICK-STEP

RIPPING OUT AN OLD ENGINE AND RUSHING IN A NEW ONE

By George H. Wallace

"WHAT is the hardest proposition I was ever up against?" repeated the trouble man Bill, in reply to my question as he straightened up in his arm chair and secured a more comfortable position. "Well that all depends on how you look at it. They are all hard propositions in a way and on the other hand any one can set up any kind of an engine and do it right—if he only knows how and has learned the trick by long and painful experience."

The men all sitting around a quiet corner in Herman's cigar store on Saturday evening were "talking shop." There was John Chapman of the Plow Works, W. B. Putnam of the Carriage Works, Anderson—"Bob" Anderson—of the Threshing Machine Works, and J. T. Foster of the Water Works.

Just at this point Dave Griswold blew in through the front door. Dave was a reporter on the Daily Journal. In fact he was the Daily Journal, having been its main spring, so to speak, for 32 years. The ordinary man has five senses. The ordinary reporter has an extra sense called 'news sense;' but Dave Griswold had seven senses, the seventh being a mixture of common sense and horse sense.

"Dave always went around with a pencil in one hand and a pad in the other and if anything escaped Dave it could not be considered as news. Dave could write shorthand. He alleged that it was shorthand. No one dared dispute him for no one could prove up. Some say that Dave invented his own system for on several occasions his notes were given to the head stenographer to decipher and she laid it all to the Black Hand and advised paying the ramsom.

George Herzog, the police reporter, sent some of Dave's notes to the Smithsonian Institute and they deciphered them as the score card of a ball game between the Julius Caesar All-Star Nine and the Marc Anthony White Sox. Some say that Dave could not read his own notes after they got cold but this story is sufficient evidence that he could. As Dave came in he cheerily enquired for news, bought a cigar, and lit it all at once.

"What was the hardest proposition I was ever up against?" said Bill. Dave looked a question at me and I answered by the same code. Dave seated himself at a table behind Bill and with his patent shorthand grasped the following:

"Well," resumed Bill, rubbing his chin and looking up at the ceiling, "it might have been down in Tennesee, where they didn't get the crane up until after the engines were running. It might have been down in Arkansaw where a political feud induced some malicious cuss to chip a few teeth on the shaft in the main bearing when most people are asleep—or ought to be.

"But, I guess all things considered that the rolling mill job up at Blatzburg furnished its share of thrills for a few hours, and if you boys care to listen to the yarn I'll tell it.

"'You're just in time,' said the superintendent to me, one Friday afternoon, as I came into his office off a trip—a hard one too—'I want you to go up to the ——— Steel Co., at Blatzburg and put that new frame on the 28-in. mill engine. I promised to have a man there tomorrow so you had better go up and clean up the job.'

"Well, I went up to the burg on the next train and over to the plant. But to my surprise, the engine was still running. Everything being arranged with the master mechanic I went up to a hotel and after leaving a call for 4 a. m. hit the hay hard.

"While I am supposed to be asleep I will describe the plant. This engine drove as has been said the 28-in. mill and as originally purchased from a St. Louis concern it was, I believe, 36 by 48 in. and ran with about 100 lb. pressure. They loaded this down, so they threw the old boilers on the dumps and put in some built for 150 lb. Well they loaded this down also getting maybe 1800 hp. or so, as against about 1200 with the old boiler. Then they decided to make a tamdem compound of it and our people got the contract to build 34 and 52 by 48 in. cylinders to replace the old simple one.

"The new piston rod was about 11 in. in diameter but it was turned down to 7 in. at the thread, this being the size of the old simple engine piston rod and also the old crosshead. This gave them about 2400 hp. with the same size piston rod in the thread as when the engine was new and built for only 1200 hp. Keep this fact in mind.

"Well after the new cylinder had been put on, one evening after supper, the old frame drew the line and in about 3 weeks it 'broke in two twoicet siveral toimes,' as the Irishman said. But they patched it up 'engeniously,' part of the repairs being 2 large billets 8 by 8 laid on the floor at each end of the frame with a 4-in. hole punched in each end and these 2 billets drawn up to the frame by means of 2 bolts 3½ in. in diameter and 22 ft. long.

"But when an engine frame is too weak, it can't be fixed right without melting it up and adding more to it, and our people also got the contract to put a new frame on our old tandem cylinders, also a new crosshead and a new connecting rod. The new frame certainly was a whale for the size of the engine, for it weighed 32 tons.

"The old piston rod being only 7 in. at the thread, of course the new crosshead had to be made to correspond. The old original engine had been equipped with one of our governors several years before so with the new frame it would be one of our engines—on the installment plan—except the shaft and wheel. The repairs had been shipped up there and yours truly was the scorched offering to do the job. When the thermometer is about 18 deg. below zero and the wind blowing across the lake from Canada at about 57 miles an hour into the open mill, scorched offering is hardly appropriate.

"Well, at 4 a. m. Saturday morning that imp of Satan, the night clerk, kicked on my door and disturbed my peaceful dream. The biscuit foundry satisfied a healthy appetite and I took the car for milltown.

"When I did get there it was still some minutes to 6 o'clock in the morning and the engine was still running. One would naturally suppose that as they were in a hurry for the new frame they would have the old one removed or at least cooled off, but it wasn't. Everything was intact but pretty rickety and at every revo-

lution the cracks in the frame would open up maybe half an inch or more and close with a bang.

"The master mechanic was right on the job, all right, all cocked and primed and wound up to the last notch. Around him stood his assistants and a small army of men; machinists, steamfitters, riggers, carpenters, masons, laborers—in fact everything but divers, and before we got done a diver would have come in handy too.

"We looked the situation over carefully while the engine was chewing its way through the last few billets, threatening to fall to pieces at every revolution 'Now,' said he, 'we have got this thing all figured out according to Hoyle and every foreman and every man knows just what to do and what not to do. Now you just stand over there by that stone (which I needed no coaxing to do), and we'll show you road men how to take an engine apart, and when we get done you can go to it.'

"Well, in about five minutes, the last billet wiggled out onto the cooling table, a dull red, narrow strip of steel, the engineer shut down, and say, before the wheel had stopped turning those 90 men fell on that engine like a lot of howling dervishes on an Arab caravan. They swarmed all over it like ants. They didn't wait to run the ropes off the governor pulley (it was a rope drive governor) they cut them off.

"The home-made oil guards on the crank were pulled off bodily and a gang jumped onto every nut, bolt, rod, and screw and in about 15 minutes it looked a complete wreck. There were 2 cranes, a 40-ton and a double 20-ton and these yanked, tugged and pulled whenever a rigger could fasten a chain. The eccentrics came off with a rush. The governor was hustled over to a place of safety for it was to be put on the new frame.

"They had even run a string of cars on which the rubbish and junk was dumped as fast as it could be pulled or broken off the job.

"The shaft with wheel, weighing about 85 or 90 tons, was raised up bodily above the bearings and a track built out on which to roll it forward about 20 ft; the wheel pit having previously been extended for that purpose. Three 40-ton whiskey jacks were put in under the frame at the most convenient places, the 40-ton crane hitched on with a 1⅛-in. steel cable and then the M. M. took off his hat and in a voice like Ringling Bros. canvas boss yelled, "Now then, give 'er hell.' Well they did, and the way that frame was broken up some more was a sight to behold. It crunched like the ice breaking up in the spring time, ripped, tore, cracked, banged, and finally the old main bearing with the forward part of the frame swung clean of the foundation and was rushed to the dump.

"The other crane stood ready with the drop from the foundry and when that ball of cast iron came down on the forward end of the slide it crumpled up like an accordeon. In the pulling and breaking process, the 2¾-in anchor bolts, which could not be removed beforehand, were bent and twisted like hay wire. But by 3 o'clock that afternoon there was nothing left of the frame but a sweet rememberance, a few bolts and any quantity of old grease, etc., and only 9 hours had elapsed since the engine was running.

"Then the masons got busy cutting the foundation down 14 in. to accommodate the new frame, and the men were as close together as they could stand, and brick and mortar flew in all dirctions. I might add here that this engine, right handed, stood so close to another, left handed, that there was just room for a passage way; in fact the low-pressure valves were so long that they could not be withdrawn on that side but had to take the bonnets off on the gear side when necessary. I expected every minute to see some one stick a bar or a sledge into the crank pit of the running engine, but a kind Providence guided their hands.

"This is where we needed a diver to go down and see that the cage washers didn't turn, but a hunkey went down with a rubber coat and hip boots on, which only served to hold the water in instead of out. He showed signs of balking, but the M. M. ruled otherwise.

"I took the big crane to unload the frame. We got the 1⅞-in. cable and made a few wraps around the frame, and at the second trial picked it up square, carried it up the shop over the heads of a score of men, and set it down on the floor near the job to drill a few holes, etc., and right here our luck favored us again, for just as the first corner of the frame touched the blocking there was a whir-r-r'up in the crane and the frame sat down on the blocking almighty sudden while the big hook followed and a lot of the crane cable came down in a tangle.

"On investigating we found that the ¾-in. eye bolt which holds the end of the crane cable to the drum had broken and nothing held the weight of that 32 ton frame but the actual friction of a few turns of cable around the drum. Why it didn't drop that frame on somebody's head, or even refuse to raise it at all is something that none present could reason out.

"Well, with lots of strong language vigorously applied where necessary, the crane was fixed again, that is, as far as the cable was concerned. But when, after a few trials I got just the right hitch on it to lift it and got it clear of the floor the brake refused to hold it and the craneman tried to hold it (at my earnest and vigorous request) by reversing the controller, but it got hot and smoked up. So did the M. M. Boys, there is no language to describe his langauge. Just hit your thumb with the hammer and what you say is about where he began.

"The electrician reported that it was impossible to hold the weight. 'Here, Bill,' said the M. M., 'it has got to hold it. Do you hear that? It's got to.' And it did, too. At last the frame was clear of the floor and hanging approximately level and I started it for the job using a torch wig wag fashion, after being coached on the signals in vogue, to signal to the craneman.

"There was just 3 in. to spare between the wheel and the rolls, above the over all length of the frame, but we finally got through cornerwise, without hitting anything and got the frame poised over the foundation. Then we found we had only half an inch to spare between the end of the piston rod sticking out of the cylinder and the blocking that supported the wheel and shaft. But the crane man was game and finally I wiggled the frame carefully down past the rod and slipped it back and onto the studs.

"Of course it was impossible to run a line through the engine so we just had to wedge it up pretty near level and squint over it and along side, like a farmer building a rail fence. But by using feelers (a thickness gage), we wiggled the frame around with 3 whiskey jacks till the gage showed the same all the way around the cylinder head, then we shoved the frame back with a jack and drew up on the studs. Three of them were twisted off but with a little compressed air, perseverance and profanity the men drilled them out and put in new ones. A 1¼-in tap was broken off in the hole by way of variety but they just left it in there for the same reason.

"They had provided for almost every possible emergency even to making short foundation bolts and sleeve nuts to screw onto those bolts that could not be removed, but luckily, all the old bolts were removed. New ones, long enough to be sure, were put in and the diver went down into the 'cradle of the deep' again. Two hundred or so steel plates 6 by 12 in. from 1-16 to 1 in. thick were provided and these driven in snug all around the frame in little piers about a foot apart and while the shop gang poured in the cement, the piston rod was screwed into the crosshead by the good old fashioned method—the chain tongs and crane.

"We had to saw an inch off the end of the thread on the rod to prevent it screwing into the new crosshead so far as to strike the end of the connecting rod. The outboard bearing having been rebabbitted, the wheel and shaft was rolled back in place. I discovered that the shaft in the bearing was worn flat on one side ⅛ in. but they considered it good enough and let it go at that. When we came to put on the new connecting rod we discovered that while the crank pin was 10⅝ in. in diameter the box had been bored 11 inches.

"It was now 12 o'clock Sunday night, and no sleep so after expressing our opinion on the absent ones who made such a close fit on the crankpin box we took it off, planed half an inch off each half, shoved the 2 halves up together with a ⅛-in. liner between and rebored it for 10⅝ in., there being enough babbitt for that purpose. To compensate for this inch planed off, we put an inch steel plate on the wedge with countersink head screws and it made quite a respectable job. Several weeks later a new box of the proper size was put in.

"I took a walk around to see if the coast was clear and it was, with the mud gang pouring the last pail full of cement under the frame. So at 3 o'clock Monday morning finding that there were enough pieces bolted together to make one complete engine, the water was turned onto the bearings, and I gave the engineer the highball and over she went, just 45 hours from the time she stopped. Meanwhile adding a new frame, crosshead, connecting rod, eccentric rods and low-pressure hook rods, and changed the location of the governor on the frame.

"We started and stopped a number of times, screwing the piston rod in or out of the crosshead—with the chain tongs—till it didn't strike either head, that is, not very hard, and juggled the high-pressure rod a little in the distance piece slide, and got it so it would run pretty fair. Then we set the valves on the run, adjusted the governor connections and at 7 o'clock the first red hot billet came sizzling down the traveler to the rolls with the engine turning up 82 revolutions, on cement you could still stir with a stick. Yet when that billet struck the rolls there wasn't a wiggle. She bit right into it, but the jar loosened up a lot of icicles which had quickly formed in the zero temperature of the mill and they scattered in all directions.

"As the billet shot back and forth a number of times it finally came out the last time, a thin narrow strip of steel, a dull cherry red, while the governor settled down on the stop and the engine, taking steam 80 per cent. of the stroke with its long range gear fairly snorted as it dug into the load. As the end of the slab snipped out of the last rolls the load was all off, instantly, the governor started to climb over the spindle, and the engine settled down to friction load till the next billet came along.

"The M. M. looked the engine all over, sized it up and turning to me said, 'Now, old man, you can go home and go to bed, you look sleepy,' and you can believe that I didn't need any particular urging, for 50 hours on a job like that in the temperature of Greenland's icy mountains, can not in any way be construed as a pleasant stroll down the beach at Atlantic City.

"Some weeks later that 7-in. thread on the piston rod dissolved partnership with the crosshead and there wasn't enough left of those 2 cylinders to hold an inquest over. Then we built a new set of cylinders and piston rods, this time with an 11 inch thread on it instead of 7, bored out the hub of the cross head to fit (it was originally made large enough for an 11-in. rod), and had the entire outfit running in just 10 days from the day she broke loose, which isn't bad considering that the cylinders are cast for each job and not kept in stock. But someone else drew the unlucky card that time. One such experience is a great sufficiency, thank you."

And Bill arose stretched himself, lit a stogie and strolled forth into the evening while the bunch around the table voted unanimously to stick by their own little engines and not take chances with fate.

BOSTON'S SMOKE LAW SUCCESSFUL

CO-OPERATION with the owners of power plants and with their engineers and firemen has been the attitude taken by the Massachusetts smoke inspector in his enforcement of the new smoke abatement law. This law became effective, in its own phrase, July 1, of last year; but it was not until the very end of November that a smoke inspector was finally appointed and set to work on the enforcement of the law. That enforcement has now covered a full period of 8 months, 1400 tests of smoke by the Ringelman smoke charts have been made; a large amount of experiment and instruction in various smoky power plants has been carried out.

As a result, Boston and the neighboring cities which come under the provisions of the smoke law are notably freer from offensive smoke, and the attitude of owners and operators is with hardly an exception that of vigorous and sympathetic co-operation with the state authorities. In one case, to be sure, the owners of a plant which burns wet shavings contends that the thick smudge rising from his stack is not really "smoke" because, forsooth, there are no cinders from it; but this is only one case.

The law provides for hearings by the board of gas and electric light commissioners before proceedings are begun to enforce penalties against any power plant; so far, however, no case has gone to the stage of a hearing. The fact that the tests are made by the Ringelman charts, and that the owner or engineer of a power plant can make the tests himself and so know independently of the inspector just where he stands under the state law gives the provisions of the statute the great benefit of absolute definiteness.

The greatest single obstacle to smokelessness as disclosed by the inspections of the last 6 months is the comparative ignorance of the great majority of firemen, and the inclination of some operating engineers to turn the furnaces over to the fireman without instructing the fireman or keeping watch of him to see whether he is doing his work properly or not. This situation is commonest, naturally, in the many smaller power plants of the district.

Usually the owner when notified that his plant was violating the law comes down hard on his engineer with orders to get rid of the smoke or clear out. This

sort of thing has proved stimulating to the engineer, and the state inspector has repeatedly found on visiting a power plant that the engineer was up on the roof watching the smoke output, while his fireman inside was applying the engineer's prescription to the furnaces in an attempt to stop excessive smoking.

Two things that have come out clearly in relation to small plants are the mischieviousness of steam jets when used by firemen who do not thoroughly understand them; and the general necessity of the coking method of hand firing. In some plants of 2 or 3 boilers, side firing has proven satisfactory but the general point in these cases is that the green coal should be spread not too thick, and should go not more than 1-3 the depth of the grate back from the doors. Steam jets, it would appear, are sold and installed in great haste, for more than a few firemen have complained to the state inspector that "they put in these jets but didn't tell us how to use 'em and we've tried all sorts of ways trying to find out."

One of the interesting points not provided for by the statute was how to use the Ringelman charts, which have black lines and white spaces, in the testing of wood smoke, which is of brown or yellow color quite different from the color of the charts. The law says, however, that smoke should be tested for its "density" and the inspector had to learn how to test the density of wood smoke by charts of a different color. This proved to be not at all difficult. It was, however, an important part of the inspector's work, for in the Boston district there are about 25 lumber manufacturing plants which fire their furnaces with wet shavings, and which have for years past poured out an immense amount of dense, sticky smoke.

Cure for these cases was really pretty easy. The shavings are blown into a tube entering over the furnace door. A little examination showed that this current of shavings, after it was set afire, was deflected upwards by the bridge wall and against the boilers, where it became so chilled that much of the fuel went into smoke and a part of the shavings were burned incompletely. Cutting down the bridge wall to about the level of the grate bars did away with this trouble.

In the larger power plants like those of the Edison Electric Co., and Boston Elevated Railway Co., the smoke nuisance has been rather serious at times past, but at nearly all these plants the installation of mechanical stokers promises to do away with the trouble. Even the Boston Elevated, however, along with some smaller plants, has been found trying to burn soft coal in furnaces designed for anthracite. The smoke results, as might be expected, have not been of a kind to satisfy the new law.

Coming down to the moral of the thing, the lesson of the Boston smoke inspection is one which has been read to engineers and firemen a great many times in the past; and one that is being urged also on the attention of the owners of plants. It is, that apart from the interest of the public, much smoke from a power plant is avoidable waste, part of the manufacturer's capital thrown away; and, further, that the remedy is generally not at all difficult, and requires only a little of the systematic commonsense thoroughness that is taken for granted in the more difficult parts of manufacturing, but seems in a great majority of cases to have stopped short in the furnace room. The facts preach the need of every man trying to find out the best way to do his particular job and then doing it that way.

RAZING A CONCRETE BUILDING

By Stuart S. Scott

IN RAZING the Baltimore News Building, in Baltimore, a 9-story structure of reinforced concrete was the most extensive operation of its kind ever attempted. The News Building was erected in 1905 at a cost of nearly $200,000 and recently when its owner, Frank A. Munsey, determined to erect upon its site a larger and taller building bids were asked for the destruction of the old building.

The George A. Fuller Co., which has the contract for the new building, agreed to tear down the old one on a cost basis within 90 days. The work began Feb. 8 and the close of April saw the foundations being rooted out.

Construction of Building

THE News Building occupied a lot 57 by 78 ft. and stood 7 stories above the ground with a basement and sub-basement, the latter being 36 ft. below the surface of the street and upon foundations composed

FIG. 1. THE NEWS BUILDING BEFORE STARTING WRECKING

of 10 and 24-in. steel I beams laid in tiers and filled between with concrete.

Columns for the structure were 18 in. square, the reinforcement being plain round iron rods 1 to 2 in. in diameter. The columns contained from 14 to 9 of these larger rods besides numerous binding rods of ½-in stuff.

The main floor beams were 12 by 24 in. made up like the columns while other beams were 12 in. square. One beam, said to be the largest of its kind, was 51 by 4½ ft., with reinforcing of 3-in. rods bound together by ½-in. binder. The columns and floor beams were spaced 12 ft. The floors were of concrete re-

inforced with ½-in. rods making up a mesh of from 5½ to 12 in. Each floor, besides the concrete had from 4 to 6 in. of cinder and broken brick facing dressed with concrete, making a total thickness of about 10 in.

The facade of the structure was of Indiana limestone backed with 10 in. of brick laid in mortar. The other walls were entirely of brick laid in cement, 2 ft. 10 in. thick at the base, 21 in. at the first floor and decreasing to 13 in. at the roof.

Method of Wrecking

REMOVAL of the limestone facing and backing, while tedious, was not difficult. The rear walls had to be torn out bit by bit with chisels and the salvage was but slight.

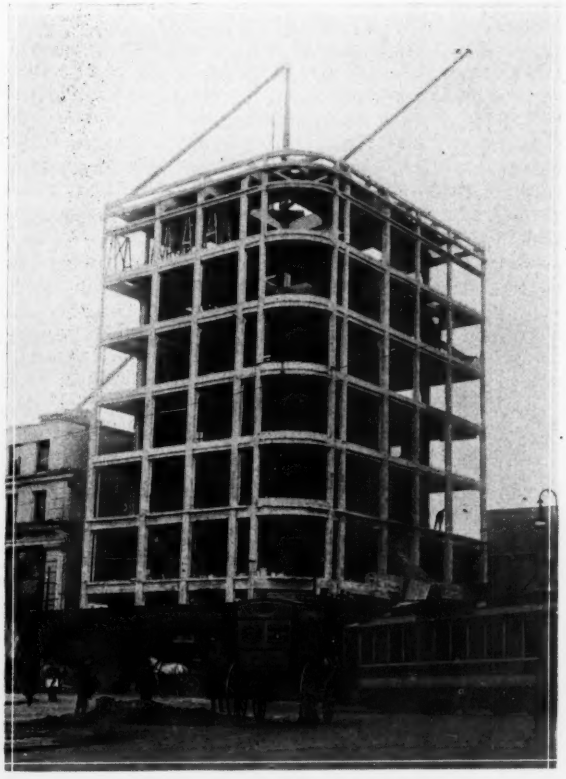


FIG. 2. REDUCED TO THE SKELETON FRAME OF REINFORCED CONCRETE

The wrecking was carried along rapidly and within one week the facade and a good portion of the rear walls were out and the skeleton of concrete stood exposed. To handle the concrete 2 derricks were erected, one on the roof of the building and one on the roof of the building adjoining.

To get at the beams and columns men were engaged with sledge hammers to break through the flooring, exposing the mesh work. Then, with an oxygen blowpipe, known as the Universal Cutter, manufactured by the Linde Air Products Company, Buffalo, the rods were burned through.

In the meanwhile an electric air compressor was set up in the cellar and lines of pipe were run to the upper floors from which lines of hose were strung off. These hose were connected to pneumatic drills and with these men chipped away the concrete of the columns and beams near the joints exposing the rods.

When the beams were cut through, all but the rods, the derrick hoists were attached. Then, with the burners, the rods were cut through and the entire sections were lifted out and sent down to the street where they were loaded upon wagons and hauled to a yard where a heavy drop hammer broke away the concrete and made possible the salvage of the iron.

After the roof and 2 stories had been removed a drop weight was employed upon the floors with considerable success and helped out the hammer gang.

FIG. 3. CUTTING OUT THE ROOF; SLEDGES AND PNEUMATIC DRILL IN ACTION

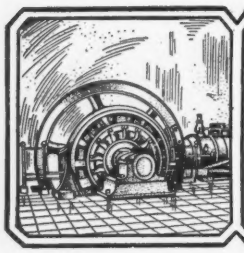
In the meantime another gang of men attacked the sub-basement where small quantities of dynamite were used to break out sections of the foundation although most of the work was done with pneumatic drills owing to the restrictions imposed by the building inspector.

While the work of digging out the old foundation was in progress the foundations for the new building, which are deeper, were set and as the old work was taken out the structure above was shored up with heavy blocks.

FIG. 4. LIFTING OUT A MAIN FLOOR BEAM

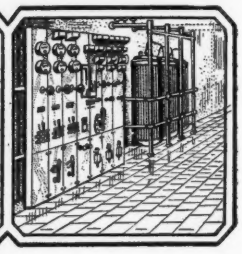
It was noticed that in none of the concrete work was the reinforcing affected although it had been in nearly 7 years. The iron was carefully examined by numerous architects and engineers all of whom declared that there had not been, as far as they could see, any chemical change in the metal.

The Fuller Co. has estimated that the destruction of the building, including the returns for the salvage, cost $30,000 which is $10,000 less than the lowest bid received from wrecking concerns.



Electrical Machinery

For Generating, Transmitting and Using Current



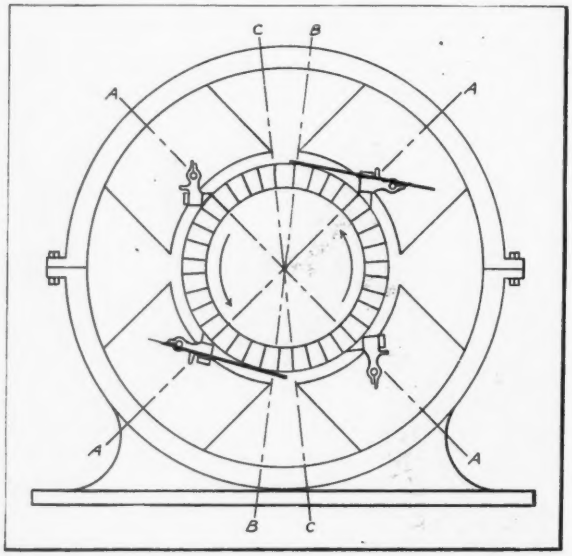
REVIVING A DEAD DYNAMO

By R. A. Cultra

IT sometimes happens in power stations on starting up a machine it will not build up its voltage. Shifting the brushes back and forth does not even bring a spark out of it. It is practically dead, at least as to exciting its own fields. But it must be started, if possible, and often in a hurry. But how?

Figure 1 may aid in this explanation. The dotted lines A A, A A indicate the neutral points of polarity at which the brushes are usually set for the normal loads, but often are advanced slightly for over loads.

B B indicates the extreme edges of the field cores, a very slight distance beyond which is the extreme advance of the polarity. With the brushes set at this point, if the brush holder yoke allows such a variation, the machine would develop its highest voltage.



APPLYING THE HUNTING STRIPS FOR EXTREME POLARITY

Line C C indicates the back edge of the field core, or the beginning of the magnetic impulse as the armature coils pass under this edge. To rock the brush holder yoke back enough to bring the brushes under this edge of the field core would diminish the voltage, bringing it down very low.

It is no trouble to the man who has made a study of magnetic fluctuations or understands this; but many a man has never had the chance to learn this part of the dynamo's operation until it refuses to operate. In this case the brushes were rocked over to the limit of the slot in the holder yoke, bringing the brushes just an inch back of the line B B. The machine showed no sign of generating, only a volt or 2 being indicated by the volt meter.

Before connecting a wire from another machine to charge the field coils, I decided to hunt for the extreme polarity, by taking 2 long strips of thin flat copper ¼ in. wide, having my assistant hold one while I held the other across the brush holder stud, allowing the point to come on the commutator just past the line B B, as shown in the sketch. Instantly there was a sparking and spitting from the ends of the strips we held. The machine started to build up and increased its voltage very rapidly.

At once I moved the brush holder yoke back to about 2 in. from the line C C. The voltage dropped as rapidly as it had risen. Shifting the brushes back to the dotted line A A, A A the voltage became normal and was then regulated by the rheostat and the machine put in service.

The machine gave no further trouble on starting and I cannot see how it became dead unless it was from the attendant pulling out the field switch about 1½ hours before the machine was stopped. There was no clutch on the shaft pulley driving this machine and it was necessary to let it run until the water wheel running this shaft could be stopped. But for some unknown reason the attendant had on this night pulled out the field switch.

SOME LARGE TRANSFORMERS

THE Pennsylvania Water & Power Co. generates power from the Susquehanna River at McCalls Ferry, where it will have an ultimate capacity estimated at 100,000 kw. At present the power generated is transmitted 40 miles to Baltimore, and transmission lines to other large cities, of which there are a number within economical transmission distance, are contemplated.

The Baltimore sub-station is at present equipped for 40,000 kv.a., and space is provided for additional transforming and switching apparatus. The present equipment consists of 4 10,000-kv.a. 3-phase transformers, which, because they are the largest transformers ever built, are of particular interest. They are of the water-cooled type, and are used to step down the 25-cycle current from 70,000 volts to 13,200 volts for distribution.

The appearance of one of these transformers is shown in the illustrations, but these do not give an adequate idea of their size. The tank is elliptical, having an over-all length of 15 ft. 11 in. and an over-all width of 8 ft. 8 in. The height to the top of the terminal is over 16 ft., and the joint between case and cover is 11½ ft. from the floor. The total weight of each transformer complete with oil is about 145,000 lb. or nearly 75 tons.

The transformers are of the shell type, water cooled. The cooling water is visible at its exit, so that any stoppage or inequality of flow in the parallel cooling

coils can be detected easily. The tanks are of boiler iron with welded seams and crowned cover and bottom.

The Westinghouse condenser type of terminal bushing is used, as the specifications called for bushings to withstand a test of 180,000 volts each for one minute. These bushings are made up of alternate layers of insulating and conducting material which, by producing a uniform distribution of dielectric stress in the insulation, enable the use of a much smaller bushing.

The method used in installing these large transformers is also of interest. On account of railroad clearances and the great weight of each unit, the core and coils, the tank, cover, base and details, and the oil were received from the factory separately. At the Baltimore substation a railroad siding runs directly into the station. Paralleling the siding in the station are the transformer compartments, built of concrete. On receipt of the transformers in the substation, it was necessary to assemble them, one at a time, on a truck running on a track having the same center line as the siding, but wider gage. The corner of this truck is shown in Fig. 2.

Lifting and moving was done with an electric hoist. After each transformer was assembled, the truck was pushed along its track to the proper compartment, and the transformer rolled in on its own wheels, the floor of the compartments being at the level of the rails on

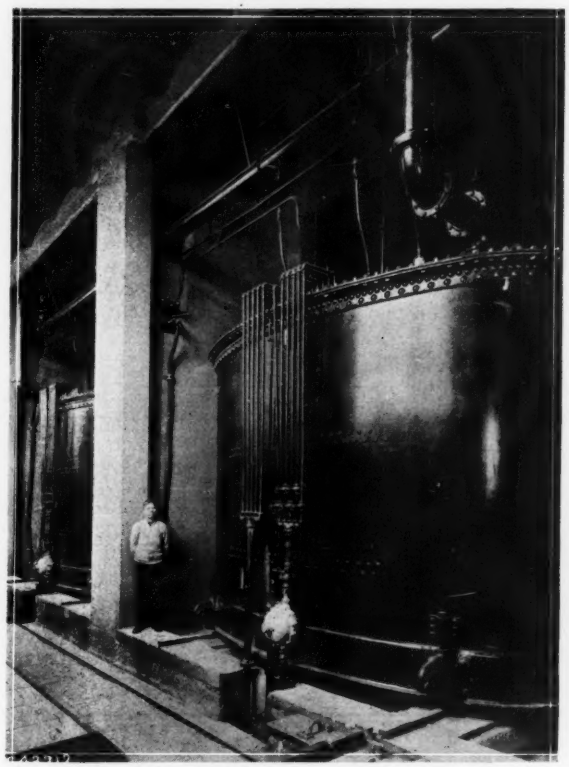


FIG. 2. 10,000-KV.A TRANSFORMER IN ITS CELL

the truck. The oil, received in tank cars, was pumped into the tanks after the transformers had been thoroughly dried out.

Underneath each transformer is a pit connected with a 10-inch main for draining the tanks in case of emergency. The top of each transformer is connected through a back pressure valve to an 8-in. main to relieve any possible rise of pressure in a tank. The arrangement is such that oil blown out of one transformer cannot enter another.

The cooling system is arranged to preclude a shutdown from lack of cooling water. Normally, water is obtained from a well near the substation. Connection is also made to the city mains for use in case of deficiency of the well, and the large storage tank on a steel tower, shown in the view of the substation, is

FIG. 1. TRANSFORMER SUBSTATION SHOWING STORAGE TANK AND METHOD OF BRINGING LINE WIRES THROUGH THE WALL

built for use in case of failure of both sources. In connection with this emergency system there is a spray cooling system which makes it possible to reuse the cooling water, the storage tank supplying only the deficiency caused by leakage and evaporation. Normally the heated water is discharged into a nearby stream.

The transformers were furnished by the Westinghouse Electric and Manufacturing Company, and were built at their East Pittsburg (Pa.) Works.

CONSTRUCTING AN OHMMETER

By R. L. Mossman

ACCOMPANYING drawings illustrate the design of an ohmmeter, or slide wire bridge, which is very compact, and will be found a useful instrument around an electric plant, for the testing of armature coils and measuring resistance. The case of the instrument, which is shown complete in Fig. 1, was made of ¼-in. walnut, of the size shown. The space under the top contains the batteries, 2 or 3 dry cells being sufficient.

Figure 2 shows the face of the instrument, which can be made of hard wood, but hard rubber makes a better looking job and will not warp. It is 11 in. long, 4½ in. wide and about 5/16 in. thick.

Details of Making

SWITCH contact G is shown in detail in Fig. 5, the length L, depending on the thickness of the top.

The brass guide pieces are shown in detail in Fig. 3, and are grooved around the edge, as shown, to take the wire F, which is about No. 26 B. & S. gage. This wire is soldered to piece G, passes around the guide pieces, as shown, and is soldered to an ordinary binding post H, the wire also being soldered in the grooves of the guide pieces. The 2 guide pieces to the right, are 9.5 in. from G and H, while the piece to the left, is 8.5 in. from the others. This makes the wire 36 in. long. The paper scale under the wire F, should be divided into inches and tenths.

Battery switch A, shown in detail in Fig. 6, is mounted to make contact on G. Resistance switch B makes contact on C, D and E, these contacts being of the same dimensions as G.

The batteries are connected to A and H, under the top. J is a small telephone receiver or galvanometer, either can be used; in the instrument constructed by the writer a telephone receiver was used. It is connected to switch B, as shown, with flexible wire, the other terminal having a small pointer or contact to slide on wire F. The resistance coils are shown at R, R′, R′′ and are connected from G to C, C to D, D to E.

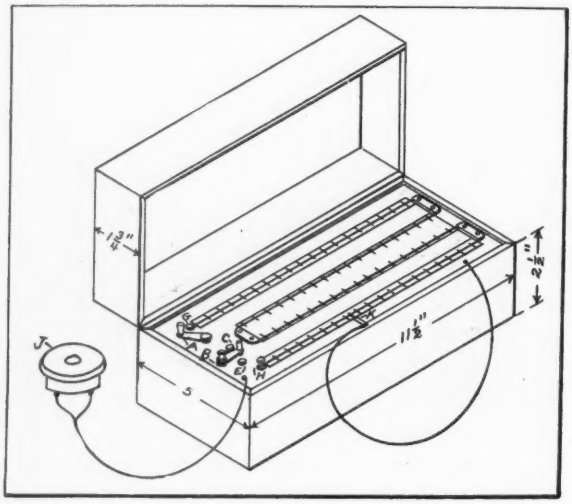


FIG. 1. OHMMETER IN CASE

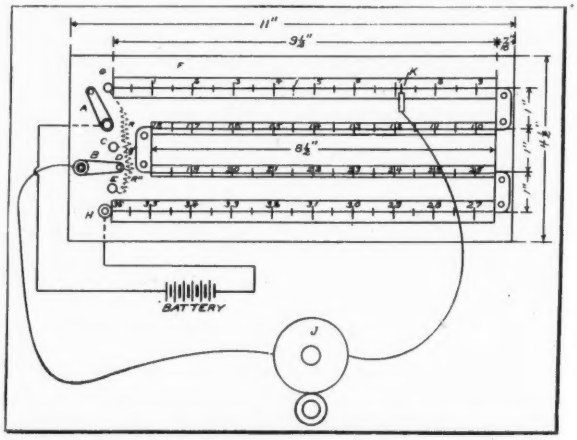


FIG. 2. SLIDE WIRE OHMMETER, TOP AND CONNECTIONS

Resistance Coils

WHEN switch B is on C, coil R is in circuit, when on D, as shown coils R and R′ are in series, when on E the 3 coils are in series.

In the instrument made by the writer, the coil R has 1 ohm resistance, coil R′ 4 ohms, coil R′′ 10 ohms, which give 1 ohm, 5 ohms, and 15 ohms, with switch B, on C, D and E, respectively. The 1-ohm coil should be made first and connected, the other coils being measured by the instrument.

These coils should preferably be made of German silver wire. The No. 26 wire used by the writer measured 13⅝ in. to the ohm, but as this wire varies, it would be best to have a piece measured on a wheatstone bridge. Connect up the 1-ohm coil, and get the resistance of the other coils as follows: For the 4-ohm coil, connect a piece of the wire, a little over 4 times the length of the 1-ohm coil, across from the binding post B, on the switch, to binding post H. Place switch B on C, close the battery switch A on G, hold the receiver J to the ear, and make contact with pointer K, along the wire F. If the unknown resistance across BH is 4 ohms, the telephone receiver should be silent when the pointer K is 7.2 in. from G, for by proportion we get that the resistance GK is to KH as the known resistance R is to the unknown; or the unknown resistance equals the distance from K to H, 28.8 times the known resistance, 1, divided by the distance from G to K, 7.2=4.

After getting the 4-ohm coil, connect it, and place the switch B on D, thereby placing 5 ohms in circuit. For the 10-ohm coil the pointer would be on 12 in. when receiver is silent, as 24×5÷12=10. Of course, if the coils are all made from the same wire, the 4-ohm coil would be 4 times the length of the 1 ohm, and the 10-ohm 10 times, but it is well to check them with the instrument. An instrument with coils of a total of 15 ohms, can measure up to about 80 or 90 ohms, with reasonable accuracy. The instrument is most accurate when the pointer is near the center of wire F. For measuring higher resistance, coils with greater resistance can be used in place of the ones described.

I have found this instrument useful in testing armature and field coils, as it will show a very low resistance, down to 0.2 ohm. For instance, with pointer at 30 in. and the 1-ohm coil in circuit it becomes

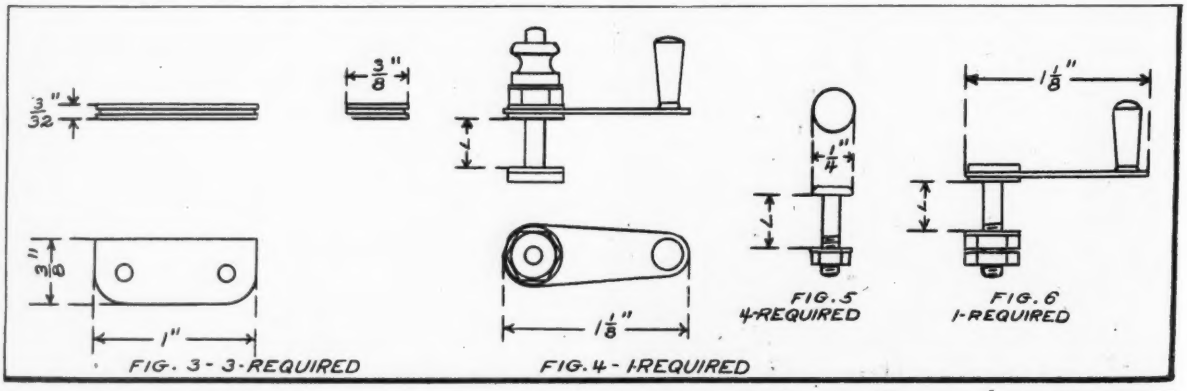


FIG. 3. BRASS GUIDE PLATE FIG. 4. BINDING POST AND SWITCH FIG. 5. SWITCH CONTACT FIG. 6. BATTERY SWITCH

6×1÷30=0.2 ohm. It will be noticed that the connections of the telephone receiver in Fig. 2 appear different than in Fig. 1; but it is the way that they are led through the top. The receiver cord is double, one end being cut off and connected to B, under the top, while the other end extends under the top and comes out to the right, with the pointer K attached to it, as shown in Fig. 1.

Locating Faults With the Ohmmeter

ACCOMPANYING Fig. 7 shows the use of the ohmmeter described for testing armatures for short and open circuited coils, and locating grounds in cables.

In Fig. 7 is shown a line or cable which is grounded at F, and it is required to find the distance of the

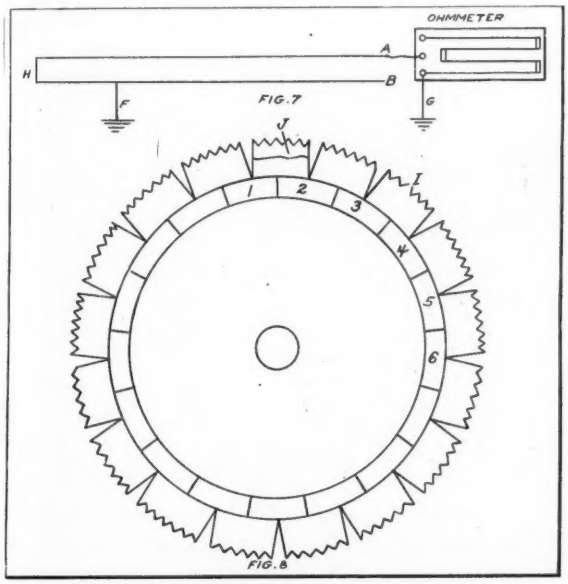


FIG. 7. MEASURING THE RESISTANCE OF A GROUNDED CIRCUIT

FIG. 8. WINDING FOR CLOSED COIL ARMATURE

ground from the ends A or B. Connect the ohmmeter to A and B and measure the resistance of the loop AB (the ends being connected together at H). Suppose that AB measures 20 ohms.

Ground the instrument at G, connect the other binding post to A, as shown, measure the resistance AF. Disconnect from A and connect to B, measure the resistance BF. These measurements include the fault to earth. Suppose that AF=24 ohms, BF=14 ohms; the resistance of AF and BF added together =38.

Subtract the resistance of AB from 38, and 38—20 =18, which is twice the resistance of F to earth, because F has been added in both AF and BF.

F=18÷2=9 ohms. If the resistance of ground F is now subtracted from BF, it will give the resistance from B to F; 14—9=5 ohms. Or from A to F=24—9 =15 ohms. Knowing the resistance of the line per mile or foot, the distance from B to F=the resistance of B to F divided by the resistance per mile or foot, as the case may be.

In Fig. 8 is shown the winding of a closed coil armature, which has one coil short circuited at J, and one with an open circuit at I. To locate these faults connect the ohmmeter to adjacent commutator segments in several places and get the resistance of the coils which are not defective. If at any point the instrument shows a resistance less than normal, it is an indication of a coil being short circuited, as at J across 1 and 2. If a considerable increase of resistance is shown, it indicates an open coil, as at I across 3 and 4, as the ohmmeter is measuring through the coils 4, 5, 6, etc., around to 3. I have located an open armature coil with this instrument when the wire was broken inside the insulation, the ends of the wire being in contact when the machine was at rest, but separating when the armature revolved. The contact being poor enough to show an increase in the resistance.

INVESTIGATIONS MADE BY the Bureau of Mines, in the course of its work on fuel tests, with reference to the proper conditions for rapid formation of carbon monoxide in the gas producer, have brought out facts which are interesting in both producer and boiler practice. The result indicates that the amount of carbon monoxide found in a gas producer or other fuel bed depends on 3 factors, temperature, depth of the hot portion of the fuel bed, and the rate of flow of gas through the bed, or in other words, depends upon the temperature and the time of contact of gas and carbon. Thus, for a given temperature—and 1300 deg. Centigrade or 2370 deg. F. was found to be the most satisfactory temperature—in a bed of fuel 1 ft. thick, with a velocity of the gas of ½ ft. a second, 90 per cent of carbon monoxide was formed, and with a velocity of 1 ft. a second, 80 per cent would be formed. In a fuel bed 2 ft. in depth, and with a gas velocity of 2 ft. a second there would also be 80 per cent of carbon monoxide formed.

The investigations demonstrated that a high temperature is necessary to produce carbon monoxide from carbon dioxide and carbon, but if a heat greater than 2370 deg. F. is used, the gases will leave the producer at a high temperature, thus lowering the efficiency of operation.

As to the small amounts of carbon monoxide found in the flue gases of boiler furnaces, the explanation most generally accepted by engineers is that the oxygen of the air first burns with the carbon, forms carbon dioxide, and as this gas passes through the hot fuel bed it combines with carbon, thus forming carbon monoxide. The investigations showed that the higher the velocity of gas, and the thinner the fuel bed, the less will be the percentage of carbon monoxide formed, so that a heavy fuel bed in a boiler furnace tends to favor the forming of carbon monoxide, and a large supply of air with a given depth of fuel bed would tend to lessen the carbon monoxide formed. It is inevitable that some carbon monoxide will be formed while the gases are passing through the fuel bed, and sufficient air should be added to the hot gases as they leave the top of the fuel bed to burn the carbon monoxide to carbon dioxide.

MANIPULATION of a hacksaw is familiar to all mechanics, yet there are some little points that may be unknown. For example, when attempting to saw a piece of tubing, if the blade is reversed in the frame the blade will operate smoothly. Also if it is desired to saw a piece of sheet metal, by placing a piece of inch board behind the sheet in the vise, the plate can be sawed through as readily as the board alone.—Machinery.

"THE MAN WHO doesn't get some comfort and some pleasure out of his daily work is in a bad way."—Chalmers.

REMODELED RONEY STOKER

CIRCULAR W. M. 504 of the Westinghouse Machine Co. shows the Westinghouse New Model Roney mechanical stoker. It is interesting to note the changes which have been made in this stoker as the result of a quarter of a century of manufacture and use. As shown in the sectional view, these changes, while not radical, are noticeable and are all in the line of effective operation and good economy. The forward edge of the pusher is now made vertical instead of being at right angles to the surface of the hopper, which allows the fuel to settle more readily and makes the feeding more uniform. A series of wedge shaped projections on the upper surface of the pusher prevent any tendency of the fuel to pack and bridge over in the hopper.

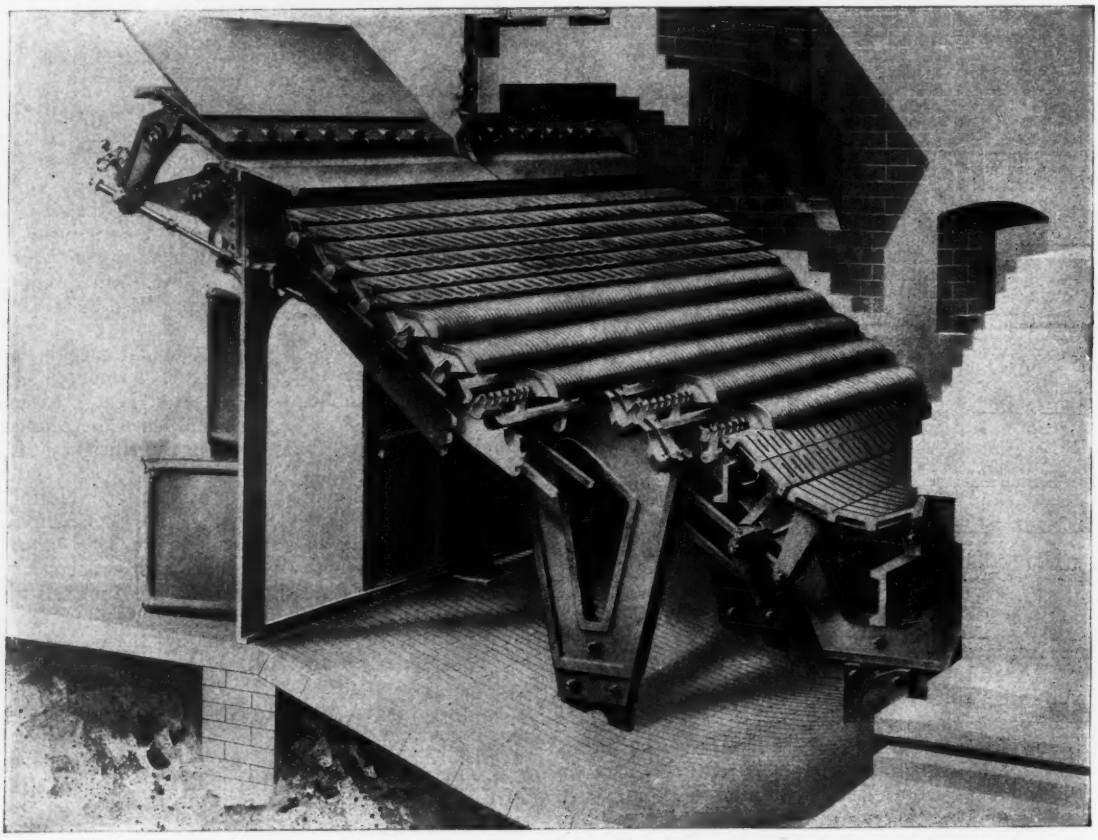


FIG. I. SECTIONAL VIEW OF NEW MODEL RONEY STOKER

At the other end of the grate lies the dead plate, which has been improved by using instead of the horizontal surface, which was not in keeping with the general inclination of the hopper plate, a dead plate with a surface practically parallel to the slope of the grate surface. The surface of the front stoker casting next the first or flat course of the coking arch has a number of projecting ribs. The casting which supports this flat course instead of being plain angle is made with horizontally projecting fingers which measure with the front ribs in the casing, thus forming a series of passages through which air admitted above the coking arch and preheated is evenly distributed across the mouth of the furnace just where distillation of the volatile matter begins in the fuel. The object of this air circulation is not only to favor smokeless combustion but to prevent the stoker front from burning or warping.

The feeding mechanism of the stoker is operated by a main shaft which runs horizontally just beneath the hopper and on which an eccentric is keyed. An arm, which is cast as a part of the eccentric strap, gives a pendulum motion to a swinging lever called the agitator, and this agitator swings on a rock shaft journaled in bearings in each of the hopper ends. To the lower end of the agitator runs a connecting rod through which the grates are rocked. A toothed sector at each end of the rock shaft meshes with rack teeth from the under side of the pusher plate and as the shaft rotates the sector moves the pusher back and forward. By means of lost motion the sector may be made to feed as fast or as slow as desirable, the length of the stroke varying.

The most noticeable improvement is in design and arrangement of grates. In the older type of grate bar there was a flat surface which was not entirely satisfactory as to durability, because the cooling surface provided was not sufficient. In the latest design of grate bar the ratio of cooling surface to heating surface is very large. The bar is built up on a wedge somewhat similar to that used in the older type, but the surface exposed to the fire, instead of being a comparatively thin and flat cast-iron shelf, is made up of a number of sections each of which presents only one thin edge to the fire. This gives very large radiating

surface, 8 to 10 times the surface exposed to the fire, so that the grates are always kept cool. The grate sections are machine molded from accurate metal patterns and, therefore, interchangeable. They are spaced regularly by notches in a rib at the top of the web or strut on which they rest and drop easily into place, locking themselves firmly into position so that no tools are required for fixing or removing them. In fact, there are some records of firemen who have been able to replace the grate sections from the ashpit without drawing the fire.

In order to preserve the general dimensions of all the other internal parts of the stoker, the new bar is made of such size that it replaces 2 bars of any of the older patterns.

In order to prevent the sifting through of small particles of fuel before they have opportunity of coking together, the older or shelf type of bar is preferred at the upper part of the grate. The heat is not so intense there and does not, therefore, affect unfavorably the durability of the bar. In order to further safeguard against the sifting of fresh fuel, the top grate bar is made fast by a stop attached to the inner surface of the stoker front and does not rock, thus forming a stop extension to the dead plate. The same method of holding and rocking the bars is used as heretofore.

At the lower end of the grate as well as a new dumping plate, is used a new form of guard. The guard is really an auxiliary dump grate and clinker breaker and serves as a barrier to prevent the fuel from sliding into the ashpit when the main dump gate is dropped. This guard is operated through a toggle system of

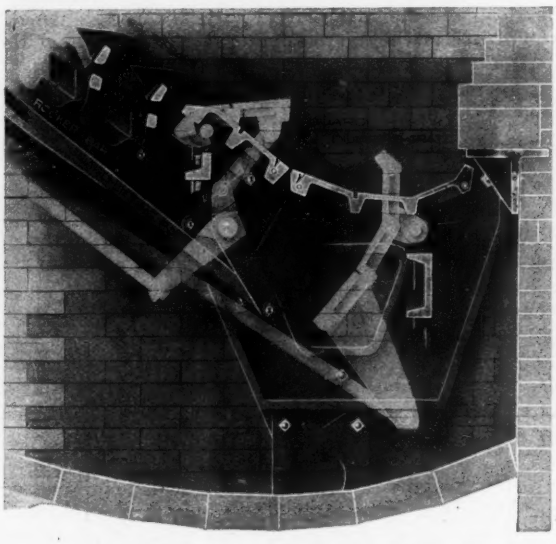


FIG. 3. LATEST DESIGN OF DUMPING GRATE AND GUARD

levers which gives a powerful effect with a much smaller expenditure of muscular effort on the part of the operator.

The main dump grate is pivoted about 1-3 its width from the rear edge and in the process of dumping the rear edge moves upward and forward, breaking up any tendency of the ash and clinker to pack and bridge over, and tearing loose any refuse adhering to the bridgewall. A change in the dumping grate is that instead of very liberal air spaces the air space is suppressed as much as possible and, if it were possible, would be eliminated entirely; but in order to prevent warping and breaking with change of temperature it is necessary to cut the surface of the grate with a few narrow slots to relieve the expansion and contraction strain.

This suppression of air space in the dumping grate has worked noticeable improvement in smokelessness and other points in the operation of the stoker. The reason is that by the time the fuel has reached the dumping plate the combustible should be entirely burned

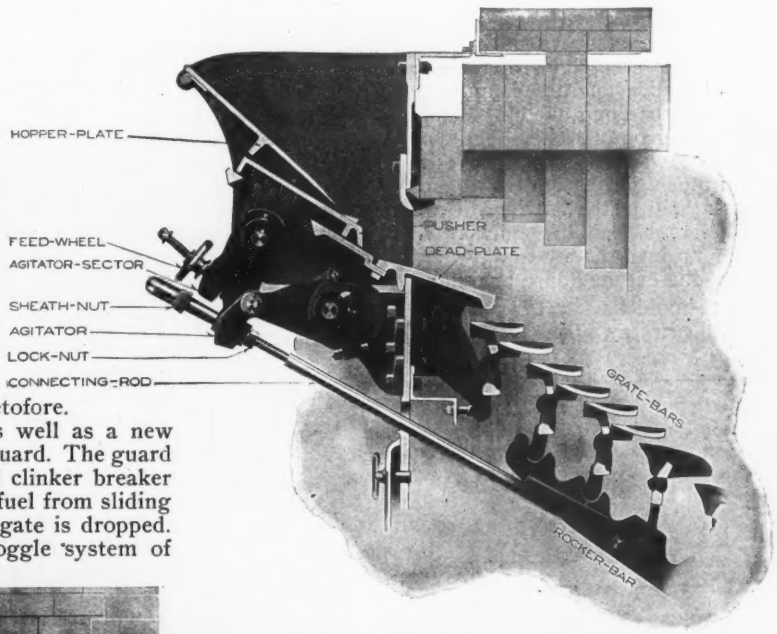


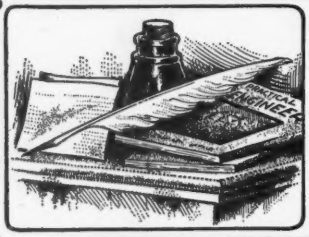
FIG. 2. HOPPER AND FEED MECHANISM

out of it so that there is no reason for admission of air at this point. As the ash and clinker, being more porous than the active part of the fuel bed, afford an easy passage for air, the air enters the furnace at this point and as it cannot combine with any combustible it is simply heated up to the chimney temperature and thrown away, which is plainly a waste. Also this supply of air cools down the gases, tending to cause smoke.

Brief mention is also made in the catalog of the Westinghouse chain grate stoker and the Westinghouse coal crusher, and numerous illustrations show the different plants where stokers have been in use anywhere from 3 to 21 years. Copies of the circular may be had by writing to the Westinghouse Machine Co., East Pittsburg, Pa.

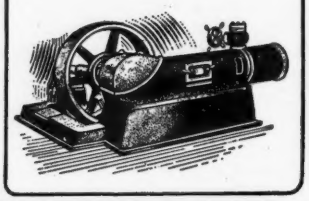
WOOD'S TABLES ON SATURATED AMMONIA published in our July issue were taken from a source where no credit for original publication or copyright was given. We find that these were originally compiled for and published in Ice and Refrigeration, and are glad to make this acknowledgment of their original source and to express our appreciation to the publishers of that magazine.

L. L. WILKINSON, of Atlanta, Ga., has recently joined the Brass Sales Department of The Ohio Brass Co., Mansfield, Ohio. Mr. Wilkinson will continue to make Atlanta his home and will travel the Southern States in the interests of Ohio valves and steam specialties.



Letters from Engineers

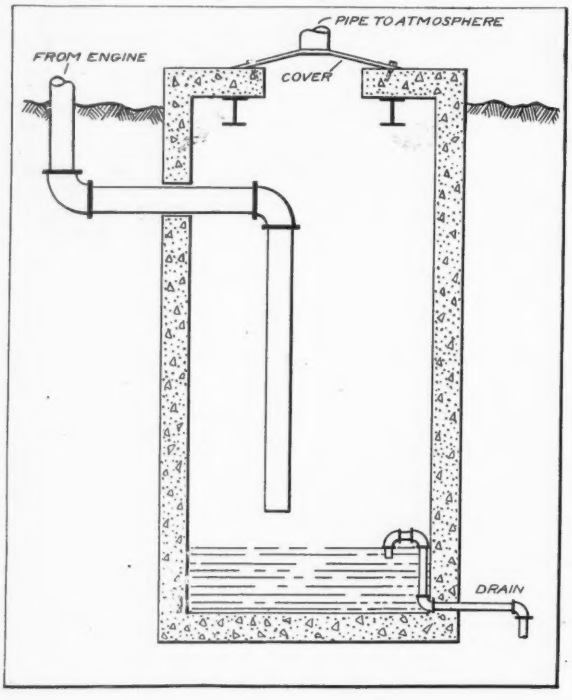
Bright Ideas direct from the plant. Send us yours. Cash paid for those accepted. Sketches desirable; we make the drawings



GAS ENGINE MUFFLER

IN reply to C. E. Nigh's question in the May number of Practical Engineer, asking for information on muffling the exhaust from a large gas engine, I would submit the following 2 methods which are very commonly used. The first is an exhaust pit, as shown by the accompanying sketch. This is a pit or well sunk into the ground either round or square with heavy concrete walls, bottom and top. The exhaust pipe from the engine enters the pit from the top or side and runs nearly to the bottom, then a vent pipe, usually a little larger than the exhaust, leads from the top or cover up into the air to any desired height, generally above the engine house or building which it is near.

It should have a drain a foot or so from the bottom to carry away the moisture. It is generally advisable to have a foot or so of water in the bottom. The top outlet should be large enough to admit a man or else have an extra trap door to enter it by.



MUFFLING PIT FOR GAS ENGINE

For a 500-hp. engine this pit should not be less than 6 or 8 ft. square or in diameter and the same number of feet in depth. The walls should be at least a foot thick.

The second method, which the writer has used in a number of cases while working as a gas engine erecting engineer, is to use an ordinary steam exhaust head, but usually one about 2 sizes larger than the exhaust pipe, that is if the exhaust pipe was 8 in. it would be advisable to use a 10 or 12 in. head. Where these exhaust heads have been used, mostly on tall buildings, the exhaust could not be heard at all from the outside.

L. M. Johnson.

FOR a 500-hp. gas engine, the simplest, most satisfactory, and least expensive muffler can be built as follows: Build in the ground a concrete pit 8 ft. square and 8 ft. deep. Use a 1—3—5 mixture; reinforce the walls well with iron rods or old ¾ or 1 in. pipe; reinforce the roof with old rails. Walls, roof and floor are to be 12 in. thick. Place manhole in the roof, frame of which is to be well anchored in with bolts of suitable size. Manhole plate must be securely bolted on. Lead exhaust from the engine into this pit, arranging small water spray to mingle with gases as they enter. Lead a pipe from this pit to the roof of the building; this pipe to have twice the area of the engine exhaust.

This is not a theory or experiment, but a muffler which works well in practice and gives perfect satisfaction. With full load on the engine the exhaust should not be heard 100 ft. away from the building. I would not consider anything else unless I had on hand an old steam boiler or large iron tank which I would use in the same manner, but there would then be the possibility of the gases corroding the iron.

The cost of the concrete pit complete should not exceed $150.

L. C. Tucker.

I HAVE never installed a muffler for an engine of 500 hp. capacity, but have had to repair mufflers on large stationary engines, because of incorrect setting. One great trouble with a good many engineers is that they think that as soon as the exhaust has passed through the valve it makes no difference what you do with it. As a consequence a great many engineers have quite a number of elbows in the exhaust pipes, causing a loss of power from back pressure.

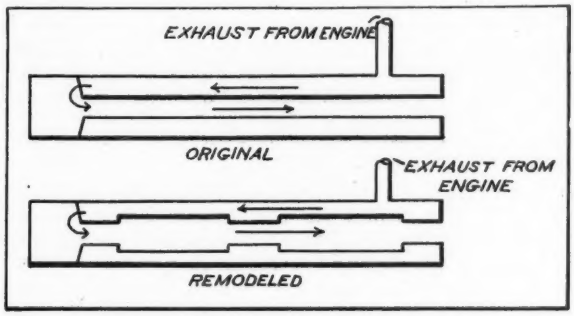
I have remodeled the exhaust pipe connections of 3 engines by placing long bends in the exhaust pipe instead of elbows. These are not as rigid as elbows and readily allow for expansion caused by the great variation of temperature.

A small pipe tapped into the exhaust pipe and connected with a water supply will help things if it is arranged so as to introduce a small, steady flow of water into the pipe. Provision must be made to remove the water by drains farther on in the pipe. There are engines in operation now which do not have any muffler at all and depend entirely on this method of muffling. The water is turned into steam and the gases cooled. This exhaust looks and sounds like a steam engine and is not objectionable.

If a cast pot muffler is used it should discharge into another muffler before being vented into the open air.

This second muffler should be larger than the first and will work very satisfactorily if built like a cistern and provided with a drain to remove the water. The farther the mufflers are placed underground the more effective is their action, although in case of repairs they are more inaccessible. Herbert H. Van Kenser.

HAVING experimented with a muffler on an automobile with a single cylinder, 5 by 6 in., I will say that I have had splendid success by using a series



ORIGINAL AND REMODELED SILENCER FOR AUTOMOBILES

of chambers. I don't believe there is a better way of silencing small engines and don't see why it would not work as well for larger ones. Jno. P. Durfee.

FLYWHEEL TROUBLE

IN the July issue, Charles Burns states that his 12-ft. flywheel runs out ½ in., and asks if it is dangerous. This, in itself, would hardly be dangerous, but, considering that the hub does not make contact with the shaft on the key side for ⅓ way around, does make it dangerous and shows plainly that the key is too high.

I have had an experience similar to this, and do not advise putting tin liners between the hub and shaft as that would give the wheel a tendency to shift sideways on the shaft.

If Mr. Burns will chalk off the wheel before shutting down the engine, and note how the running out corresponds with the key, I think he will find the extremes of the wobble on the diameter through the key. Mr. Burns does not state what the type of hub is, but I take it for granted that it is the split type. The clearance between the hub and shaft should be measured, and the key drawn and dressed down as much as the clearance, which will allow the hub and shaft to fit, and the wheel will run true if the hub has been bored true.

When replacing the key, the bolts on the hub should be drawn up tight before driving the key, as driving the key first and then drawing up on the bolts will put the hub in a strain if the key is a little high. M. W. Utz.

GLYCERINE AND LITHARGE JOINT

ON page 419 of the June issue, is an article by J. C. B., entitled Mixture for Ammonia Joints, from which I most respectfully beg to differ as to the use of litharge and glycerine for either steam or ammonia pipe joints, and especially for ammonia

Have used litharge and glycerine successfully in repairing leaky radiators, steamfitting, etc., but was a partial failure on pipe joints by reason of strains caused by expansion and contraction of pipes, thus causing the joints to crack and slight leaks of steam or hot water would be the result, and barring the possible inconvenience of such leaks they amount to nothing in dollars and cents, but when they occur on an ammonia system it is quite another proposition, hence the writer never attempted to make a screwed pipe joint with litharge and glycerine, or any other pasty mixture on ammonia joints.

In order to insure tight joints that will stay tight, it is absolutely essential to have substantial fittings and pipe with clean, sharp standard threads, using a little flake graphite and oil, and by screwing up good and hard iron to iron, you have a lasting job. On the other hand, by using litharge on the same joint you will not be able, with the same power, to screw it in as far as it was before by possibly half a turn, because of the particles of litharge between the threads, and in case of ammonia under pressure it will simply be a question of a little time when the ammonia will have penetrated the litharge and a leak will be the result, and this leak may occur when the repairing may mean quite a loss, and to continue to leak until later is a loss in ammonia, to say nothing of the odor permeating the building.

In the writer's judgment, the use of litharge and glycerine on pipe joints should only be resorted to in case of an emergency. W. S. Luckenbach.

EMERGENCY JOINT CLAMP

THESE illustrations show you an emergency clamp for steam pipes that are leaking around the thread.

The clamps are made in 2 sections or 2 clamps. Clamp No. 1 to go over the leak and against the fitting with a piece of sheet gum wide enough to go between the pipe and clamp, also to bend around side of the clamp so that the gum will be between the side of the clamp and the fitting.

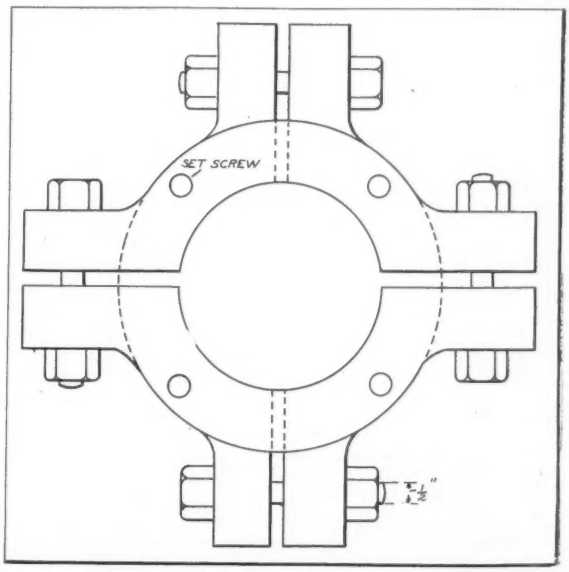


FIG. 1. EMERGENCY CLAMPS SHOWING THEIR RELATIVE POSITIONS

Clamp No. 2 is bolted tight to the pipe and made rigid with the set screws that go down through the clamp.

And with the set screws in the side of clamp No. 2, clamp No. 1 is forced up against the fitting.

Clamps are made from ⅞-in. square iron and shaped up to a good fit on a piece of pipe the required size. The holes for the set screws should be drilled a little on an angle so that the point of the set screw

will point towards the bottom of clamp No. 1. By the set screws being on an angle, the bottom of clamp No. 1 is forced up tight against the leak. It also

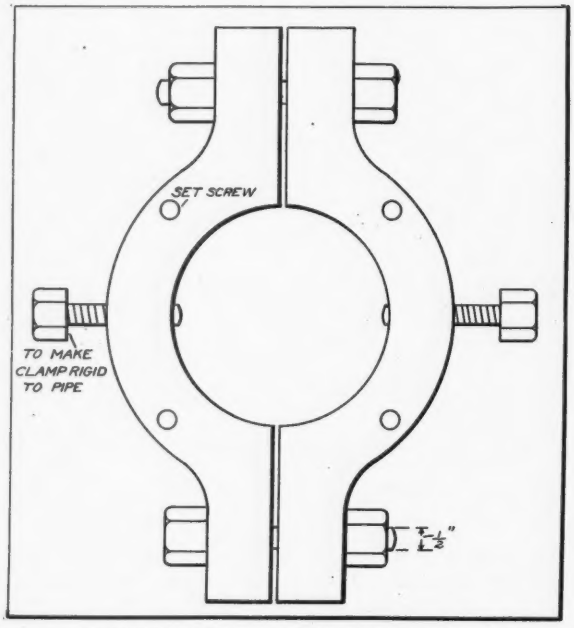


FIG. 2. OUTSIDE CLAMP TO BE FASTENED TIGHT TO PIPE

gives more clearance to work the wrench when tightening up the screw. In bending the clamp, the ends

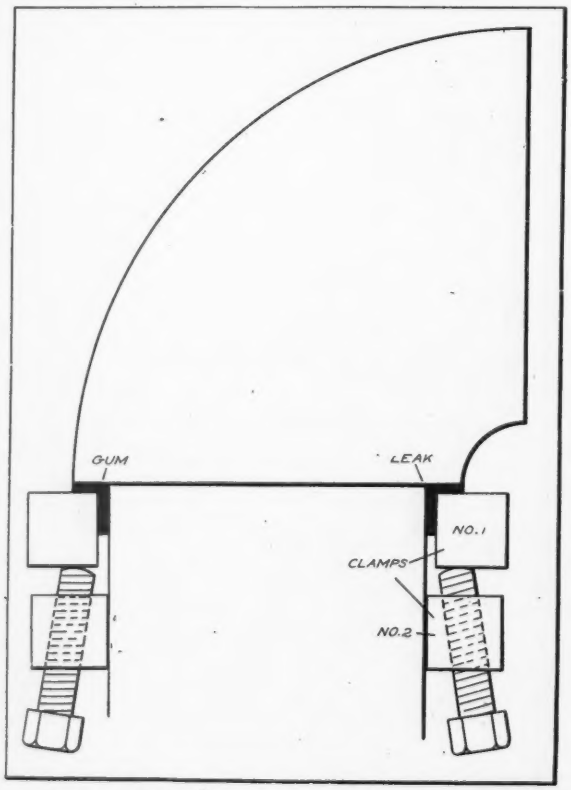


FIG. 3. CROSS SECTION OF CLAMPS IN POSITION

where the 2 halves come together should be worked up square so that the clamp will have a full bearing on the pipe. Not having any set screws, ⅜ or ½-in. carriage bolts make good substitutes by cutting off the head close, leaving the square part just beneath to work the wrench on. The thread can be cut up close to the head with a small hand die. I have made 4 sets of clamps for 4-in pipe and find they do excellent service. John Treweek.

EXHAUST PIPE; DRY KILN

SOME of the engineers are having trouble with the exhaust pipes of their gas engines where water is turned into them to prevent a noisy exhaust. We are afflicted in the same way and intended to use cast iron until somebody complained that cast iron did not last much better than the wrought iron. We intend now to get extra heavy wrought iron pipe and have it threaded in the lathe so as not to disturb the structure of the metal. We notice that corrosion always attacks threaded pipe worst at the threaded portion and ascribe it to the fact that the action of the dies upset or break up the fiber of the iron at this point.

I do not think that it is always the boiler compound that causes the corrosion of glass gages; have handled boilers 30 yr. in many of which I never used compound, but the glasses were eaten or worn away the same, I do not remember a single instance where this action did not take place.

Inasmuch as the bottom end of the glass does not waste, I have thought the action must be due to a corrosive gas liberated from the water. It is either this or the action is due to the distilled water running down the glass. Another gage glass mystery is why a glass will always break if touched inside by an iron wire. It will nearly always do this, though sometimes not for hours afterward.

Mr. Burns is evidently having a difficult time with his dry kilns. I would try to do away with the water under the kiln, as I understand the drying depends on the natural circulation of the heated air, and the less moisture carried by the air before it is heated the better the results.

It has always been my belief that the hot blast system of heating is much more efficient as you have a forced circulation of the air and can turn it in at its highest temperature at the end of the kiln where the lumber is taken out and it leaves the kiln at the end where the green lumber has just been put in. A cold water coil may be placed in the intake ahead of the heating coils to condense some of the moisture carried by the air before it is sent into the kiln; thus it will be in the best condition for drying.

He should, by all means, get his condensation back to the boilers, especially at night, when using live steam. A difference in temperature of 100 to 200 deg. of feed water would mean about 9 per cent less work for the boilers to do. He should look well to the outlets of the coils that he does not have a great loss in steam there. They should drain to a closed receiver, and the water should be pumped back to the boilers with the least possible loss of heat.

If he returns the condensation in the daytime when he is using exhaust steam, some means of removing the oil must be adopted, otherwise he may have trouble with his boilers. Pumping the condensation through a good open heater, where he heats his make-up feed water, will remove most of it. Either the pump or water supply should be float controlled so that the water will not be pumped down in the heater, otherwise such oil as gathers on top of the water will be pumped into the boiler. Such a heater needs flush-

ing out 2 or 3 times a day. If it has a good overflow this will usually take care of the oil on the surface of the water. But if he cannot get a heater, make a large cistern with a partition across it and openings through the partition at the bottom, and discharge the condensation in one side and pump out of the other.

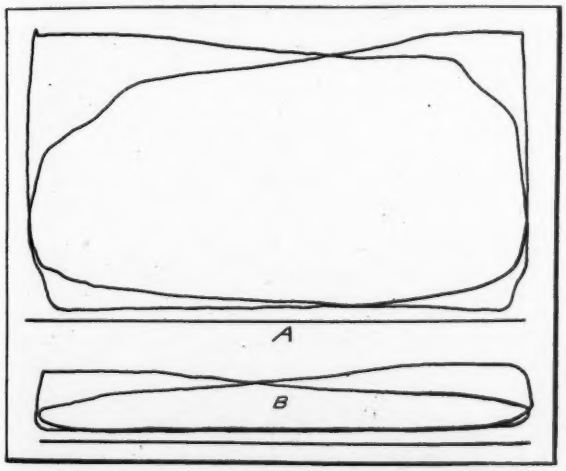
It should not be much trouble to take some of the wobble out of his wheel with well-fitted shims. Theoretically a solid hub is not supposed to touch on the key side.

Not many years ago it was thought that a steam or power hammer would break itself up if set on anything but a timber foundation, and it was with some misgivings that we concluded to try a couple of power hammers on a concrete foundation. Since then there has been nothing but concrete used under the 60 hammers in the forging department, except a 2-in. plank between the concrete and hammer frame, and this without increasing cost of repairs, and a very great reduction in the cost of foundations, as timber soon rots out in the dry earth usually found in such places. J. O. Benefiel.

SAW MILL CONDITIONS

WE were very much interested in Mr. Durfee's "Antics in a Saw Mill," in the May issue of Practical Engineer. Having read several articles along the same lines, I must say that the casual observer would be led to believe that saw mill engine rooms are places of amusement, where the amateur class is always in evidence.

Some engineers may think that a saw-mill engine runs under the same conditions as an engine in a flour mill or where the load is constant, but this is not the case; take for instance, our 15 by 20-in. slide valve Atlas



SUCCESSIVE CARDS FROM SAWMILL ENGINE

which, by the indicator measurement, has a load varying from 36 to 160 hp. within half a dozen revolutions. It runs 10 hr. every day with a 20-penny spike sitting on end on the cylinder, and it goes in and out of the cut without a tremor.

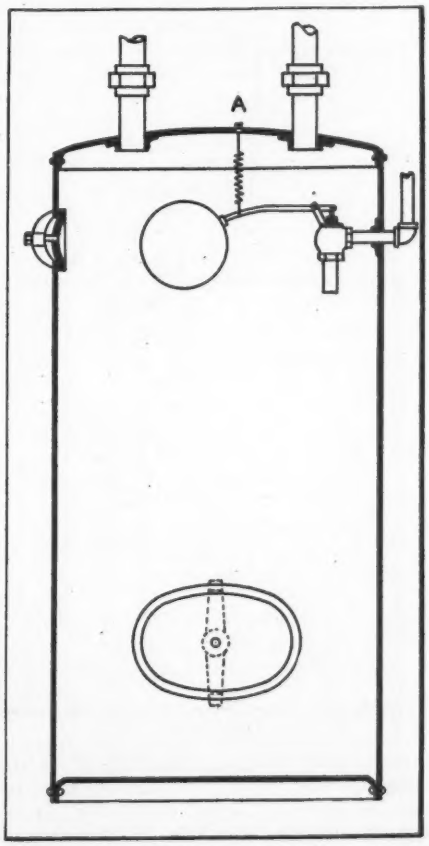
We are 40 miles from a machine shop, and I think you will find that the average saw mill engineer is not an engineer in name only. N. W. Duell.

WATER LOGGED FLOAT

NOTICING C. L. Herrick's description of water logged float troubles in the July number, recalls a similar experience which the writer had, but one more difficult to remedy.

After an extended absence of several weeks, during which time alterations were being made, it was found that a green man in our plant allowed a concrete wall to be erected 6 in. from a 30 by 60 in. receiving tank, completely covering the manhole, and thus making the interior of the tank absolutely inaccessible, aside from a small handhole opposite the tank regulator. This handhole, however, was too small for removing and replacing the float which had become filled with water, thereby causing the valve to remain partially open and flood the tank.

How to remedy the difficulty, without getting into the tank was somewhat of a problem, until the following scheme was evolved: The tank was emptied, top connections removed, handhole opened, and a ⅛ in. tapping was made at A. A spring of sufficient tension to just about sustain the weight of the float was then wired to the lever and pulled through the ⅛-in. opening with a string. A ⅛-in. brass plug was drilled and countersunk to fit the wire, the end of the wire being simply headed over to prevent it from slipping back into the tank while plug was made up.



WATER LOGGED FLOAT IN RECEIVER TANK

The loose joint thus formed prevented the tension of the spring from being changed while plug was being screwed into place. When plug was tightly made up, a drop of hard solder fastened the wire and plug together, making an absolutely tight joint.

When the tank was refilled the float had its usual buoyancy, as the spring supported the weight of the water in the float and at the same time allowed the float to operate as before.

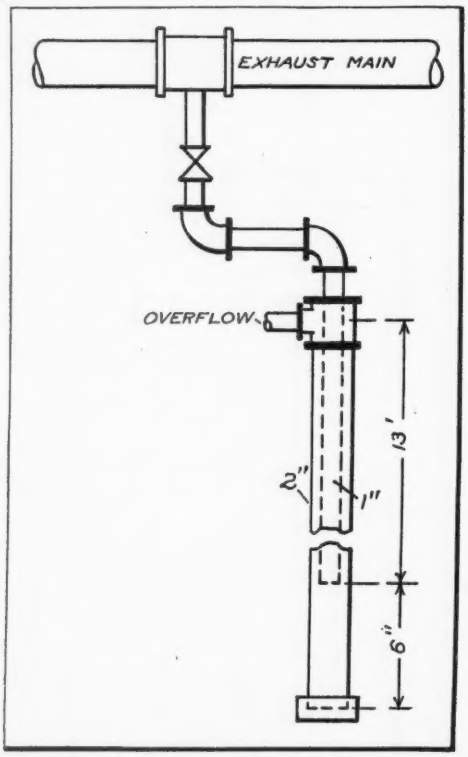
The general repairman who carried out the above suggestions on the tank, had occasion to use the same

idea a few months later with a water logged float in a water closet tank. No spring being obtainable, he used a thin springy lath, which was placed across the top of the tank, the float being suspended from the lath by a piece of cord. By means of this simple device the same results were obtained as if a spring were used.

This closet has been in use for over a year in this condition and at last reports was still being used with a float half filled with water. Wm. Simpson.

HOME-MADE LOW PRESSURE WATER SEAL

IN a large steam plant of which I took charge for some time, I found many water pockets and dead end pipes which were not trapped. One in particular was an 8-in. exhaust line running some 300 ft. from the engine to about 20 ft. past the manifolds in which the exhaust steam was used. It had a plugged tee on the end with a 4-in. hole intended for a drainage pipe, in the bottom, plugged up. When steam was turned on this line, the



HOME-MADE WATER SEAL

vibration from water hammer was very great and often caused leakage at the joints from unequal expansion and contraction.

As there was no trap available and the usual method of getting orders through the office was very slow, I constructed a water seal as shown in the sketch, and connected it up to the main. There being only 5 to 6 lb. back pressure on the line, I made the inside pipe 13 ft. long, from the overflow and the outside pipe 13½ ft., leaving 6 in. clearance at the bottom which was capped. A 2-in. tee was used at the top of this 2-in. piece of pipe, the overflow being connected at the side of the tee. A 2 to 1-in. bushing was screwed over the long thread on the 1-in. pipe, which had been placed down inside the 2-in. pipe, the bushing being screwed into the top of the tee. A coupling was then made with a union and nipple from the projecting end of the 1-in. pipe to the valve connected in the bottom of the exhaust line. This seal worked well and I installed several others to relieve the pockets in the pipes from the water of condensation. R. A. Cultra.

RECEIVER PRESSURE

AMONG other interesting articles in the June issue, I notice the "Questions and Answers For First-Class License," page 435. I wish to speak in particular about question and answer No. 4. The answer given is all right and corresponds to the question exactly, but why should it be necessary arithmetically to work out the receiver pressure of a compound engine when the real way to determine it is by actual trial?

As there are conditions surrounding every compound engine, drop in pressure due to condensation, for example, which change the results as figured, it would seem that in the end it would be better to take indicator diagrams from the engine and from them determine just what the receiver pressure should be for best results, and make the necessary adjustments to secure that pressure.

Somebody has said that the receiver pressure to be carried is "that which, with a given load, will cause the governor balls to float in the highest plane." That cannot be figured out exactly, but it can be found from indicator diagrams and a series of trials with different pressures. The best results are obtained with that pressure which carries the load with the least amount of steam going through the engine, and the indicator is of great value in determining that matter.

Charles J. Mason.

GENERATOR VOLTAGE

REPLYING to a query by a correspondent regarding the falling off of voltage, in the June issue, I submit the following explanation:

The resistance of copper increases with an increase of temperature. Consequently after the dynamo has run for a time the shunt windings take less current, due to their increased resistance, and the voltage at the terminals drops. The heating of the field rheostat further increases this drop. Twenty volts drop from 110 seems a little large and is probably caused by an excessive heating of the field rheostat, due to its being too small.

Furthermore, the motor load increases with the temperature, that is, the shunt field and rheostat of motor heat up, weakening the field and increasing the armature current taken, this again increasing the drop across the dynamo terminals. The compounding may not be sufficient to overcome this.

I believe, however, that excessive heat in the dynamo field rheostat is the principal cause, and this can be remedied by putting in one with a larger capacity.

V. E. Johnson.

IN the June issue, a correspondent outlines some troubles he is having with his voltage. He states that no regulator is used on the shunt field winding, and that the voltage when the machine is first started up, is 110, but after the machine is run for an hour or so and the speed remaining the same, the voltage drops to 90.

He further states that the machines run quite cool, etc. But right here is the cause of his drop in voltage. When he first starts up the machine, it is cool in all its parts. If the machine has been standing idle all night, the shunt fields are as cool as any other part of the machine, which is at about the same temperature

as the engine room, which is likely cooler at this time than it will be in an hour or two later.

It is obvious then that the resistance of the shunt field coils are at their lowest, at this time, and no rheostat being used, the largest possible amount of current will now flow through them, which, in this particular case, is just right to bring the voltage up to 110, with the machine running at its normal speed. But as it is impossible to pass a current of electricity through any conductor without raising its temperature, and as the resistance of a conductor (except carbons) increases with the temperature, therefore, his shunt field coils, after 1 or 2 hours' run, have warmed up, and their resistance has increased, thus allowing a smaller amount of current to pass through them, which, in turn, would cause his voltage to drop; and all this, notwithstanding the fact that his machine runs comparatively cool.

At one time I had charge of a plant where there were 2 generators of exactly the same style and make; and they were driven by engines exactly similar. It was customary to run 1 machine at night and both in daytime. In the morning, when I would start up the machine which had been standing idle all night and adjust its voltage to the same as the one which had been running all night and throwing them together in parallel, they would both take hold of the load equally and the voltage would not change, but after an hour or two, I would find that the machine which I had started up in the morning was lagging behind; that is, it was not pulling its share of the load, and the voltage would be down. By merely cutting out a little more resistance in the shunt field rheostat of this machine I could bring the voltage back up to normal, and also equalize the machines. After this I would not have any more trouble along this line until one of them was allowed to cool off, when the same thing would occur again. John Craig Scott.

I NOTICED on page 433 of the June issue that a correspondent has trouble with the voltage of his generator. From a similar experience, I am inclined to think that the falling off in voltage is due to the increased resistance of the shunt field, due to a rise in temperature of the field coils, which is caused by current passing through them. Although the temperature of the field coils may not be very high, the increase might be enough to increase the resistance of the field enough to lower the line voltage quite a little, this would be more noticeable if the generator is not over compounded.

In my case with an up-to-date 3-wire compound generator the voltage will drop from 6 to 8 volts across the outside wires—the machine being wound for 118-236 volts—in the first 2 hours' run with a steady load, unless the shunt field resistance is changed. This decrease in voltage is shown by the recording volt meter to be gradual and uniform, beginning a few minutes after the machine is started, also the decrease is larger with a light than with a heavy load; the reason for this, I believe to be that with a full load the over compounding compensates for part of the drop caused by heating as well as the reduced strength of the shunt field. We have 3 of these units exactly alike, and the same trouble is noticed on all of them. The temperature of the machines does not increase very much over that of the surrounding air and the speed is as steady as an up-to-date high speed engine can be made to run.

If the correspondent has a belted unit I would suggest that he either change the pulleys to get an increase of speed or raise the speed of his gas engine say 3 or 4 per cent, as a trial, and insert a rheostat in the shunt field to control the voltage, or if he does not wish to go to the expense of a rheostat, which would be small, he can make a water rheostat that will answer the purpose.

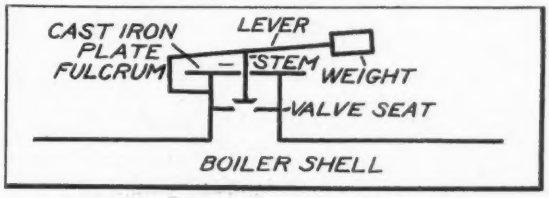
If his engine has a flyball governor, as many of the medium-sized gas engines do, it may be possible for him to change the speed of the engine while running to compensate for the change in voltage, increasing the speed as the voltage drops. In these suggestions I have assumed that the decrease in voltage is not caused by starting a large motor or due to over loads, in which case the same remedy might or might not apply, depending on the circumstances.

J. C. Hawkins.

A WEDGED SAFETY VALVE

ONCE at least in the varied experience of the average stationary engineer comes the moment to judge the cause from the effect, and what is more to the point, to judge quickly and accurately. To fittingly illustrate this I take the following incident as told to me by a friend:

The plant is located in a certain Ohio town which, of course, owing to the state law requires a license



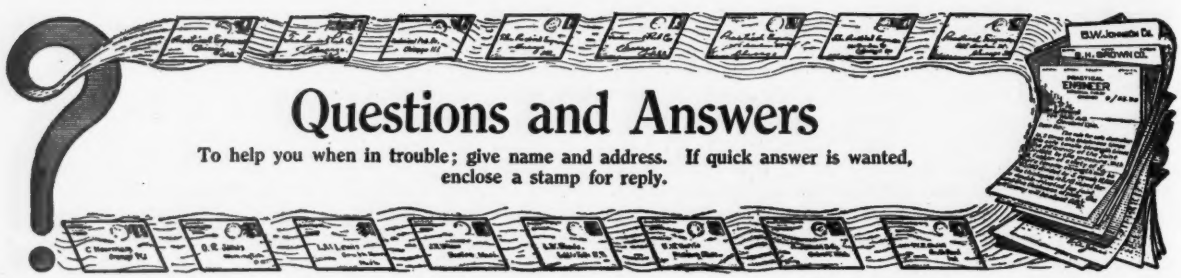
SECTIONAL VIEW OF WEDGED SAFETY VALVE

of any person in charge of steam boilers or engines, although not nearly so strict when it comes to permitting an unsafe boiler to be put and kept in operation. The plant in question had been shut down for some time and when at last the time for starting up arrived, my friend had been secured to take charge of the engine and boiler rooms.

He was well known about town and a considerable crowd had collected in the boiler room to watch him get the old kettle fixed up. The boiler was a return-tubular of about 100 hp. and considered safe for 125 lb. pressure.

My friend had filled the boiler with water to the proper level, started a brisk fire and everything seemed to be working all right and would have been all right if no pressure had been raised. Well, in due time the working pressure was reached and the safety valve—an old weight and lever affair—popped, and kept on popping until not one pound of pressure remained, my friend at once guessed the trouble, closed the draft, smothered the fire and increased the feed.

His crowd of lookers-on started a cross country dash at the first sign of trouble and advised him in no gentle terms to do likewise but he quietly told them that he preferred to remain where he was, and where they found him when they came sneaking back a half hour afterwards. The trouble was that the hole for the valve stem of the safety valve had become oval instead of round from long use, and an imperfect fitting in the first place, and when the valve stem raised through this hole, and started to close when the pressure was reduced, it became wedged in the narrow part of the hole and of course could go no farther. The sketch will give some idea of the construction of the valve. Le Roy Scott.



Questions and Answers

To help you when in trouble; give name and address. If quick answer is wanted, enclose a stamp for reply.

THE CHIEF ENGINEER'S CATECHISM IV

WHAT is the cause of smoke and how may it be removed?

2. Does absence of black smoke indicate good combustion?

3. Define the difference between a cold air and a hot air stack.

4. What are the usual chemicals used for purifying water by cold treatment?

5. Why should water be scientifically analysed before devising a treatment?

6. What is the object of a live steam purifier?

7. At what speed should different kinds of pumps be run to get the best results?

8. What are the most essential features in boiler feed pumps?

9. What is the use of check valves in feed water piping and where should they be placed?

10. Where are blowoff valves placed? Which do you consider the best type and why?

(The best set of answers to these questions will be paid for at the regular rate, and the author of the second best set will receive a prize of $3. Answers will be published in the October issue, and all answers should reach Practical Engineer not later than September 1.—Editor.)

Adjusting Corliss Valves to Fit Rebored Chambers

AFTER the valve chambers have been bored out on a Corliss engine and valves re-turned, how can I tell if the valves could ever be re-turned again? After reboring, why is it necessary to pin the back bonnets and the brackets? Do all types of Corliss engines have to be pinned after reboring? H. C.

A. If both the valves and valve chambers of a Corliss engine require machining it is usually found more practical and economical to insert new valves to fit the chambers after reboring, as the amount that the valve would ordinarily have to be thrown off center in order to clean up and fit the larger chamber would be so great that the relation of the ports would be distorted considerably and interfere with proper steam distribution.

It is not possible to tell whether or not the valves could again be turned down if necessary, because this is governed entirely by local conditions.

It is not necessary to pin or dowel either the back or front bonnets, as these are usually turned with a shoulder to fit into a recess or counterbore in the end of the chamber. The only exception is where the exhaust chambers set partly within the bore of the cylinder, as is usual with the Wisconsin Corliss engine, in which case the exhaust valves are provided with stop pins working in a circular slot in the back bonnets to prevent the valve from turning around in the chamber and interfering with the piston should the exhaust valve gear become broken or deranged, and thus prevent serious trouble. G. H. Wallace.

ANSWERS TO CHIEF ENGINEER'S CATECHISM II

QUESTIONS IN THE JUNE ISSUE

By C. B. Hudson

CARBON is defined as a solid and exists in coal in a combined state in the volatile gases, and also in a free or uncombined state.

The carbon existing in a free or uncombined state is known as fixed carbon. By the admission of the required amount of air to the furnace the fixed carbon combines with the oxygen of the air and forms carbon dioxide commonly known as CO_2.

This chemical combination furnishes the chief source of heat in the burning of coal.

Volatile matter consists of gases which are capable of being distilled from the coal at moderate temperatures usually passing off when the fuel bed has reached a red heat. A majority of these gases are combustible but some are not. All coal when mined contains a certain amount of water chemically termed moisture.

Coal is capable of absorbing or releasing moisture according to the condition of the atmosphere to which it is exposed.

Ash consists of the mineral and other solid matter not capable of being burned and is present in varying quantities according to the grade of fuel.

2. The following table shows the values of fixed carbon, volatiles, moisture and ash in American anthracite and bituminous coals.

	Per cent fixed carbon	Per cent volatiles	Per cent moisture	Per cent ash
Anthracite.....	75 to 90	2 to 7.5	1 to 3.5	5 to 16
Bituminous	35.5 to 73.5	23 to 49	1 to 18	3 to 18

Owing to its more porous nature bituminous coal is more capable of absorbing moisture when exposed to the atmosphere than is anthracite.

3. The principal difference lies in the size of the combustion chamber which should be larger for bituminous coal owing to the larger amount of volatile gases in this grade of fuel which must be consumed before coming in contact with the boiler surface while the small amount of volatile gases in anthracite coal is consumed in or just over the fuel bed.

The draft will not vary greatly; while anthracite is higher in carbon its lumpy nature will allow enough air to be drawn through the fuel bed with the same draft that would be required to supply air for bituminous coal.

4. The ratio of heating surface to grate surface depends on the rate of combustion it is desired to maintain and the efficiency of the shell and tubes in absorbing the heat thus generated.

Fire tube boilers vary from 35 to 45 sq. ft. of heating surface to 1 sq. ft. of grate area.

Water tube boilers vary from 40 to 55 sq. ft. of heating surface to 1 sq. ft. of grate area.

5. For anthracite coal high in carbon and low in volatile matter good results can be obtained with a combustion chamber 1½ times as large as the fire box, as combustion takes place in or near the fuel bed, semi-anthracite requires from 1½ to 3 times the volume of the fire box, while semi-bituminous and bituminous require from 4 to 8 times the fire box volume.

6. Draft is measured in inches of water or fractions thereof and is usually taken from the fire box or near it.

One cu. in. of water weighs 0.03616 lb., hence a draft equal to one inch is equivalent to a pressure of approximately .04 of a pound.

7. Carbonates and sulphates are chemicals known in a general way as salts and are soluble in water under certain conditions; for instance carbonates of calcium and magnesium are found in water which is charged with carbonic acid gas.

Both carbonates and sulphates are scale forming substances.

8. Carbonates and sulphates are found in water because of the fact that the water has absorbed them from the soil through which it has passed.

The character and amount of these substances will depend upon the character of the soil through which the water flows and the chemicals contained in the water for which the carbonates and sulphates have an affinity.

9. The following amounts are the averages of 9 samples of water taken from 9 different states:

Carbonates 10.6, sulphates 40.66, totals 51.27.

Results are in grains per gallon and are for well water, water in streams would show much less as the opportunity for absorption is not as great.

10. Most of the carbonates will be precipitated when the water is heated to 212 deg. F. while the sulphates require about 300 deg. or a little over.

By F. Wells

1. When coal is first supplied to the furnace, the volatile gases are first distilled off and until these gases have been disengaged from the coal, no burning of the solid part takes place. This changing gradually into coke or fixed carbon. Ash is a term used to define the incombustible elements of the coal and is found as a residue after the combustible products have been burned. Volatile matter is a term used to define the lively gases in the various forms of hydrocarbons, that are disengaged from the coal at a very low temperature. When these gases are exposed to a much higher temperature they are decomposed and pass successively into lighter hydrocarbons, and finally, after all of the carbon is consumed, into hydrogen. All coal contains hydrogen and oxygen and these elements combining in a proper proportion form water. This is known as the moisture and is very detrimental to the heating value. All coal exposed to the atmosphere absorbs a certain amount of moisture from the air.

3. Anthracite coal is known as a slow combustion fuel, and to provide that a certain quantity shall be consumed for a given size of boiler, either the grate surface must be increased, as compared with bituminous coal, or the intensity of the draft must be increased. From this arises the fact that when burning anthracite coal in a furnace designed for bituminous coal, either an extra high stack is required or forced draft is used.

The ratio of grate surface to heating surface for best practice in different types of boilers is:

	Sq. ft. of H. S. to 1 sq. ft. of G. S.
Plain cylinder boilers	12 to 15
Cornish boilers	15 to 30
Cylindrical tube boilers	20 to 25
Marine tubular boilers	30 to 40
Locomotive tubular boilers	50 to 100
Water tube boilers	40 to 60

5. There is no fixed standard between the firebox and the combustion chamber. The combustion chamber, which usually forms a part of a well-designed furnace, may be either simply an enlargement of the height of the furnace itself to obtain the space and time necessary for a complete intermixture and thorough combustion of the gases, or it may be any separate chamber beyond the grate. The latter is the better method of securing the desired results, but, the more usual plan is to give considerable more height to the furnace crown. In locomotive boilers a small combustion chamber is unavoidably employed and in water tube boilers the combustion takes place in the furnace and around tubes. The size of the combustion chamber would, therefore, depend largely on the type of boiler. The section over the bridge-wall should be about 1/7 of the grate area for anthracite and this works well for bituminous.

6. Amount of draft, under ordinary conditions, is governed by the height of the stack and is expressed in inches of water, that is, the intensity of the draft is known by the height of a column of water it will support expressed in inches or parts of an inch. To find the maximum draft for any given stack, the heated column being 612 deg. F. and the external air 62 deg., multiply the height above the grate in feet by 0.0075, and the product is the draft-power in inches of water. The measurement necessary to be taken would be the height of the stack above the grates.

8. Carbonic acid consists of a mixture of carbon and oxygen. As the water flows along the earth's surface, some of the oxygen in the water combines with carbon found there and forms carbonic acid. This carbonic acid, in turn, combines with the magnesia, lime, etc., found in the earth, and forms carbonates. Sulphuric acid is a compound of oxygen, hydrogen and sulphur. The oxygen and hydrogen of the water combines with the sulphur, found in the earth, and forms sulphuric acid; this in turn, combines with the magnesia, lime, etc., and forms sulphates.

ANSWERS TO OHIO EXAMINATION QUESTIONS*

IT is a fact well known by operators of Corliss engines that the governor must be in a certain position to cut off at a certain point, and that the valve must travel a certain distance also before it can be tripped or steam cut off. When the engine is running the reach rod is connected to the wrist plate and from the wrist plate to the hook which opens the valve. The valve travels a certain distance according to the position of cut-off, but if the engine is shut down the position of cut-off is changed. Therefore to start the Corliss engine under the conditions named, first release the reach rod from the wrist plate, then place the wrist plate central, then open the throttle valve a little and if you are accustomed to a Corliss engine open the steam valve, by using the wrist plate, behind the piston in the direction in which your engine

*Answers 1 and 3 are from John Mitchell, and 2 and 4 from Wm. E. Dixon.

runs. Keep your eye on the reach rod, as it is easier to follow than the crank. When the direction of your reach rod changes, move the wrist plate in the same direction as the reach rod is traveling, but do not move your wrist quite as much as the travel of the reach rod. By doing this way your engine will be started and continue to turn over, after the engine has made a few revolutions connect your reach rod to the wrist

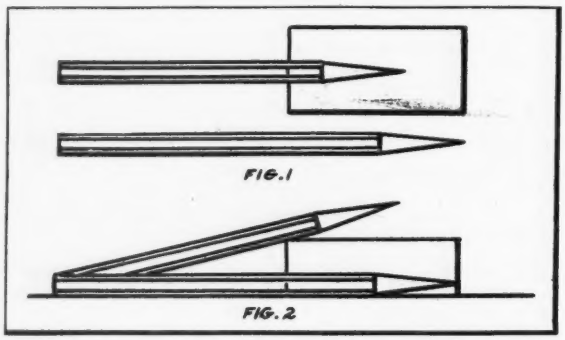


FIG. 1. PLAN VIEW OF PENCILS APPARENTLY PARALLEL
FIG. 2. ELEVATION OF PENCILS IN FIG. 1

plate. If your wrist plate does not travel as far as the reach rod when you are operating it by hand but just enough to keep your engine turning over you can hook the reach rod onto the wrist plate between the time of passing in one direction and back again while you are running slow.

If you are not accustomed to a Corliss engine first release your reach rod from the wrist plate, then put

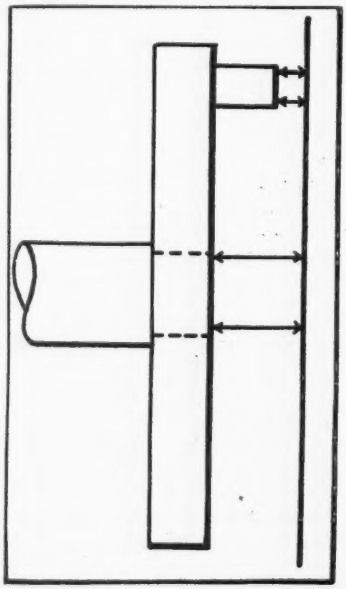


FIG. 3. TESTING ALIGNMENT OF CRANK PIN

your wrist plate central, then open your throttle valve a little. Then open the steam valve on the engine, by using the wrist plate, to get the piston back to the starting position, then put your wrist plate central, close the throttle valve, work your wrist plate backward and forward to get the steam out of the cylinder. Then connect your reach rod to the wrist plate and then turn on enough steam to carry the engine over the dead center, gradually turn on more steam until the engine is up to speed when your throttle valve can be opened full.

It is bad practice in some cases to turn an engine backwards, especially when copper brushes are used on electric machinery or crossed belts are employed, as you are liable to bend the brushes and throw the crossed belts off.

2. If we wish to be certain that the center line of 2 objects, or, in fact, any 2 lines, are parallel, it will not do to be satisfied with only one test. Viewed from one direction 2 lines might be perfectly parallel, while viewed from another they might be far from it. For instance, the 2 pencils in Fig. 1 seem to be perfectly parallel. We are looking down upon them. Observe them now from one side and we have Fig. 2, where one is resting on a box and the other lies flat on the table and evidently they are not parallel. Remove the box and let the pencil fall vertically to the table, and

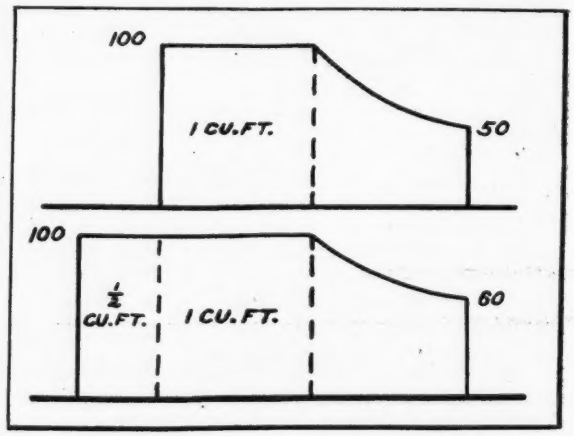


FIG. 4. EFFECT OF CLEARANCE ON CARD

we shall then find them parallel from any point of view. Thus we must view them in 2 planes to be sure that they are parallel.

Just so with our crankpin. We must test it in a vertical plane and a horizontal plane. We must try it "on center" and "on quarter." If the pin is new or in good condition, level the shaft and then put the level on the pin in both quarter and center positions. If the pin shows itself level in both positions then we know the 2 center lines are parallel.

If, however, the pin is badly worn so as to raise doubt of the accuracy of this method, a line and calipers may be used. With the shaft level drop a plumb line opposite center of the crank pin, placed on quarter, and caliper as in Fig. 3. When the 2 measurements to the pin are equal and the 2 to the face of the shaft are equal we may know that the 2 center lines are parallel in this plane. Now turn the crank to center and drop a plumb line in front of the pin and caliper to the upper and lower edges of the face as before. If both measurements are the same we may know the pin is square, for the shaft has already been tested.

If, however, the 2 measurements are unlike for either position, the pin is out of square, the 2 center lines are not parallel.

3. The pressure in a boiler should be as uniform as possible because all metals change their length with a change of temperature, a change of pressure means a change of temperature and also a change in the length of the boiler. The more equal the pressure is kept on a boiler the less expansion and contraction will take place, also better results would be obtained from the

engine using steam at a uniform pressure. Iron expands 0.00008232 in. per foot of length for every rise of 1 deg. in temperature, steel expands 0.00007188 in. per foot of length for every change of 1 deg. in temperature.

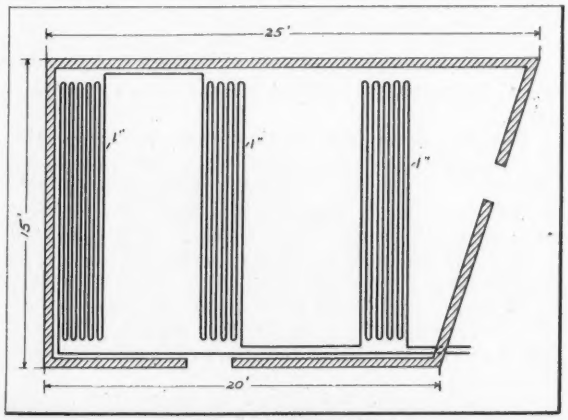
4. Let us suppose a cylinder without clearance. Let us assume its cubical contents as 2 cu. ft. and a cut off at one-half stroke, and steam at 100 lb. absolute. The steam and expansion line will then look like that in the upper part of Fig. 4. One cu. ft. of steam will expand into 2 cu. ft. and the absolute terminal pressure will be 50.

Let us now add a clearance of 25 per cent of cylinder volume, or ½ cu. ft. The steam line will now be represented by the lower part of Fig. 4; ½+1 cu. ft. of steam have expanded into 2½ cu. ft. and the terminal pressure will be 1½÷2½×100=60. The admission line is the same height as before, and the expansion line is higher, thus we have a greater mean effective pressure. The more clearance we have the more steam we have admitted up to the point of cutoff. And as this larger volume expands it must do more work. More clearance means higher mean effective pressure.

Let us look, also, at the compression. With small clearance compression will run high; but as we add clearance, the enclosed steam will find more room at the end of the stroke and thus compression will not be so high. And no matter how desirable it is in other ways, no matter what we may think of its economy, etc., compression does subtract from the mean effective pressure. More clearance means less compression, hence at this end of the stroke, also, more clearance means greater mean effective pressure.

Heating a Kiln

I WOULD like to have somebody answer a question in Practical Engineer in regard to drying a kiln. We have a dry kiln used for drying bass wood and pine, small stock sawed 1¼ to 3 in. Dimensions of the kiln are 20 and 25 ft. long by 15 ft. wide by 10 ft. high.



KILN TO BE HEATED

floor space piped with coils of 1-in. pipe, from the boiler room to the kiln is about 50 ft., vent in kiln at top 2½ ft. square, is also heated with live steam. Can somebody tell me how to regulate this kiln. I thought probably we didn't have enough ventilation, as it takes 6 or 8 weeks in the winter to dry this green stock. Would putting in a blower pipe help this any? We are in a hurry for the stock and it does not seem to work at all lately. A sketch of kiln is shown herewith.

P. L. Hatch.

Card Criticism

THESE cards were taken from a Lowe-Bodley Corliss engine, running at 71 r.p.m., No. 1 condensing with a 25-in. vacuum and No. 2 noncondensing. The engine running noncondensing runs quiet and as good as any engine could, but condensing there is a hard

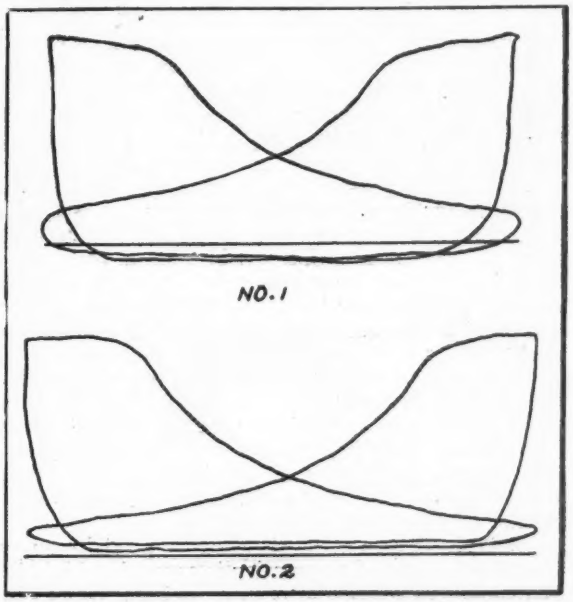


FIG. 1. CONDENSING AND NONCONDENSING CARD FROM CORLISS ENGINE

pound on the head end as it passes the center, otherwise it runs nicely. I have done everything I could but cannot find the cause. I think it must be in the compression.

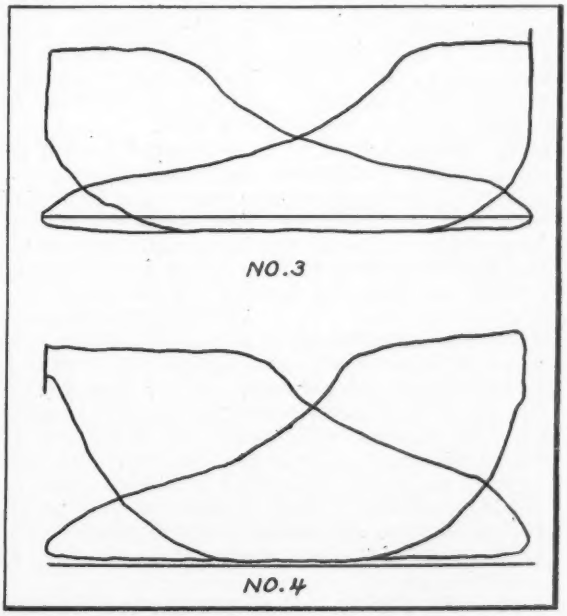


FIG. 2 CARDS FROM FITCHBURG ENGINE RUNNING CONDENSING AND NONCONDENSING

Numbers 3 and 4 were taken from a Fitchburg engine under similar conditions, the speed being 125 r.p.m. and the vacuum 20 in. How can I get a better card from each engine? Is there anything in the card that

would cause the pounding in the Corliss engine?

T. H. Tucker.

A. The head and crank ends are not marked, but looking over the condensing and noncondensing cards for the Corliss engine it seems that the point at which the pressure on the compression curve equals the pressure on the expansion curve comes much nearer the end of the stroke for the condensing card than for the noncondensing. There will, therefore, be much less time for the compression pressure to take up the inertia of the moving parts when the engine is condensing than when noncondensing, and a higher compression would be needed.

This probably is where the trouble comes and if you increase the compression somewhat it will take care of the pound on the head end when running condensing. Of course, this would give a little more compression than is needed when running noncondensing, but you may have to stand this loss in order to get quiet running of the plant under the 2 different conditions.

In regard to the cards from the Fitchburg engine, the admission seems to be a trifle late on both these and it would seem desirable to turn the eccentric ahead just a little. Also there is later cutoff on the left-hand card than on the right-hand and it would seem desirable to change the length of the valve stem so as to equalize the 2 cutoffs.

Aside from this the cards are very good for an engine of that type. Compression is somewhat high, but that cannot well be avoided with Fitchburg valves and at the speed you are running it is likely that this compression is needed in order to bring the reciprocating parts to rest.

Making a Rheostat

THE central station of which I am superintendent delivers direct current at 220 volts and nearly all stereopticon shows or theatrical troups coming here carry 110-volt rheostats with their machines. Resultantly I am called upon to rig up water rheostats quite frequently, which is quite a nuisance. I would like to have detailed directions for building them from common material such as iron wire. I want one to carry current from 2 to 10 amperes, 1 from 5 to 20 amperes, and another from 15 to 50 amperes.

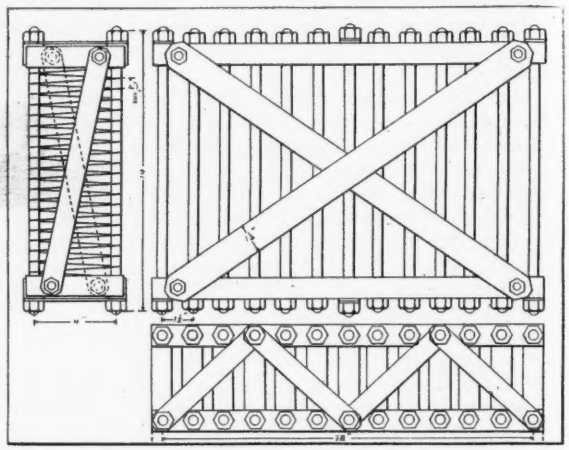
Could I wrap a common piece of 4 by 4 timber with asbestos paper and then wrap the iron wire around this or should the framework be open to allow air to circulate? Give length of iron wire required for each and sketch of how to make it.

C. Dickerson.

A. Making a rheostat such as you desire, of iron wire will be practically impossible. You wish to take up 110 volts in the rheostat, as I understand it. The wire must be of capacity for the smallest rheostat to carry 10 amperes continuously. In a well ventilated frame this would call for No. 12 iron wire, and in order to use up 110 volts when 2 amperes current was flowing you would need a length to give 55 ohms. Number 12 iron wire takes 90 ft. to the ohm, so that for 55 ohms you would need 4950 ft. or about ⅞ of a mile.

For the 5 to 20 ampere rheostat you would need No. 8 wire, 22 ohms, and it takes 250 ft. of this to the ohm, so that you would have to have 5500 ft. of this, or over a mile.

The best material for your purpose is some form of special resistance wire, such as is furnished by Herman Boker & Co., 101 Duane St., New York City. They have several brands. For your smallest capacity rheostat the best brand would be the "Superior" resistance wire. This, wound on a well ventilated frame, not a solid block, could carry 10 amperes on a No. 19 wire and has a resistance of 401 ohms per 1000 feet, which would call for about 140 ft. of the wire to give you 55 ohms resistance, or about half a pound, and the expense for bare wire would be small.



HOME-MADE RHEOSTAT

For the 20-ampere rheostat, No. 18 wire of the Nickeline II brand would seem most suitable. This is rated at 18.2 amperes continuous, but would probably carry 20 for a considerable time. This has 126 ohms per 1000 ft. and for 22 ohms you would require about 175 ft., or about 0.82 of a pound.

For the 50-ampere rheostat you could use a No. 14 Nickeline II brand, which is rated at 45.5 amperes. To use up 110 volts at 15 amperes would call for 7 1-3 ohms or 147 ft. of the wire, about 1¾ lb.

The method of arranging this would be to build a stiff frame of slit work well braced, cover this with strips of asbestos at least ⅛-in. thick at all points where the wire would touch, and wind the wire on the frame, connecting the ends to terminal posts which should be mounted on hard rubber or asbestos board plates.

The accompanying sketches show the proportions of a substantial rheostat the framework of which is made entirely of iron. The rheostat is made up of sections upon each of which is wound 16 ft. of resistance wire. A square frame is made of 2 ½-in. bolts 14 in. long threaded 1½ in. at each end, on the end sections angle irons are used with holes bored 4 in. on centers to hold the bolts apart, on other sections 1½-in. strap iron is used for this purpose. The end pieces are held in place by a nut on each side, as illustrated.

Before winding the section the bolts are wrapped with sheet asbestos which may be held in place during the winding by applications of shellac. The whole section can be put in a lathe and wound with the resistance wire which should be drawn tight, the turns being about ½ in. apart.

The different sections are assembled 1½ in. on centers by bolting them to 4 angle irons as shown in the illustration and in order to keep the rheostat rigid it must be braced substantially. This rheostat is open and gives plenty of ventilation for carrying off heat. The coils may be connected in series or any desired series parallel arrangement.

PROPORTIONING EXPANSION BEND

LENGTH OF DIFFERENT SIZES NEEDED FOR ANY AMOUNT OF EXPANSION AND FORMS OF BENDS USED

FOR taking up expansion in lines of steam piping, various forms of bends may be used as shown on p. 420 of the June issue of Practical Engineer. When this method is adopted, the question arises, "How long should the bend be made?"

Evidently this depends on the amount of expansion to be cared for, and the size of the pipe, since a given length of small pipe can safely bend more than a length of larger diameter. At first thought it might seem that the length needed depends also on the form of the bend, but consideration of how the bend acts to take up expansion will disprove this.

The pipe bend acts simply as a spring, the distributed bending of the bend serving to take up the motion of the end of the run of pipe; as a certain amount of motion can be taken up by each foot of the bend, it follows that the longer the pipe which is in the bend, the greater is the motion that can be cared for. So far as the spring per foot is concerned, it makes no difference whether the pipe is straight, circle, a U bend or a reverse curve. In any case the pipe acts like a beam with an end load.

The relation becomes simple and can be expressed by a series of curves as given in the Data Sheet.

In making up a bend, the strain on the metal in bending makes it unwise to use a radius less than 5 pipe diameters, although in extreme cases a smaller is used as shown in the Data Sheet table furnished by the Best Mfg. Co.

The expansion as shown in the Data Sheet curves is based on a fiber stress of 12,000 lb. in the bend, which gives a factor of safety of 5 to 6 depending on the quality of the metal.

From the curves on Data Sheet for the June issue it is possible to get the amount of expansion for any length of pipe run; and the curves and table in the accompanying Data Sheet give the length of pipe needed in a bend to take up that expansion, the smallest safe radius and the length of straight end needed beyond the curve.

To illustrate this, take the case of a line of 2 in. pipe 50 ft. long to carry steam at 125 lb. pressure. From the steam table, the temperature at 125 lb. gage or 140 lb. absolute is 352.8 deg. F. This would be 300 deg. rise above the atmosphere, and from the June Data Sheet the expansion would be 1.1 in. Looking at the curves on August Data Sheet the curve for 2-in. pipe crosses the 1-in. expansion line on the 11-ft. vertical line; hence, a bend 11 ft. long is needed. By the table, 2-in. pipe should have at least 3 in. length straight at each end of the bend or 6 in. total which leaves 10½ ft. to be made into a bend. If it be a loop or circle, the radius would be 3 ft. 4½ in. For any other form of bend the length could be made up of arcs of not less than 10 in. radius, and straight lengths most convenient. In this case the radius needed for length far exceeds the minimum allowable.

Again take a 6-in. exhaust line 30 ft. long, carrying steam at 3 lb. pressure. The temperature is 222 deg. F. or a rise of 172 deg. which would cause 5/16 in. expansion, calling for 11 ft. of pipe in the bend. The straight bends need 13 in. or about 1.1 ft. leaving 9.9 ft. for the bend, the circle having 3 ft. 1½ in. radius. The minimum advisable radius would be 2 ft., 6 in., so that the circle is safe; but, if the line were much shorter or the steam temperature lower, the circle would need be made larger than the expansion really called for, or else some other form of bend than the circle used.

J. P. FLEMING

MR. FLEMING'S start in engineering work was in the public service, as is his present activity. While engaged as cashier in the office of the Chicago Athletic Association he became interested in engineering and electrical work and was taken under the wing of Edward Gray, at that time chief engineer of the plant connected with the Athletic Association, and was given his first lessons, beginning at the coal pile and working up to the switchboard.

While in this plant Mr. Fleming had an interesting experience with an installation of the Edison dynamo, at that time just coming into use, but the lighting plant failed to reach its guaranteed performance.

Having laid the foundation for a successful engineering career, Mr. Fleming left the Athletic Association to become electrician with the Electric Park Amusement Association, and served with that concern until 1898, when he left to go with the Seventh Illinois Volunteer Regiment as quartermaster sergeant of Company A at the time of the Spanish-American war. After 6 months' service he returned and secured a position under John Shay as fireman and later obtained employment in the engine room of the Masonic Temple under the chief engineer, Mr. White.

The structure of engineering knowledge and ability which was being reared on the foundation laid when with the Athletic Association was not growing quite rapidly enough, however, to suit Mr. Fleming, and in 1902, in order to gain more knowledge and experience in electrical work, he located with the Western Electric Co., starting in the finishing department and afterwards working on the testing floor and as inspector of armatures, field coils and transformers. This work went on until 1906, when through a civil service examination a position was secured as 7th grade engineer with the Board of Education of Chicago.

Since that time Mr. Fleming, by steady promotion and examination, has arisen to the 10th or highest grade of operating engineer in the city service and is now in charge of the Von Humboldt School buildings located at Tollman Ave., Hirsch and Rockwell Sts. This plant consists of 3 return tubular boilers, 18 ft. by 60 in., a Worthington duplex feed pump and Johnson duplex air compressor, Marsh vacuum pump, 8 by 12 Atlas engine, and 12 by 15 Skinner engine, with motor equipment to drive wood-working machinery, house pumps, ventilating system, etc. The buildings are heated by the plenum system of forced ventilation and house about 1800 children and 50 teachers.

Mr. Fleming has frequently held office in the different engineering associations of the city and is at the present time vice-president of Local 143 composed entirely of school engineers, and is president of the T. J. Waters Branch of the Institute of Operating Engineers. He has taken active interest in work for the elevation of the operating engineering profession and is laying out a broad and comprehensive plan for the work of the branch during the coming season.

CHIMNEY DESIGN

WHATEVER the construction of a chimney its duty is to produce sufficient draft to effect complete combustion of the fuel on the boiler grate and to carry off the waste gases. Draft requires height of chimney and in order to handle the volume of gases the chimney must be of sufficient diameter. These exact dimensions depend largely upon the kind and amount of fuel to be burned, the design and relative arrangement of the boilers and flues and the altitude of the plant above sea level.

No satisfactory formula has been developed for calculating chimney dimensions but the methods employed are based to a great extent upon results obtained by experience.

Tables and curves are printed in the Practical Reference Tables of this issue, which may be used in proportioning chimneys for power plant purposes, the method being revised from that originally published in Stirling.

The first quantity given is the horsepower of the boilers. From this it is necessary to assume the volume of gas which will be given off when the boilers are all working at about 50 per cent over load. The curves showing the diameter of chimney at sea level was plotted with the assumption that 120 lb. of gas an hour would be discharged for each horsepower rating of the boilers, this assumption takes care of overloading and allowance for poor coal. From this curve we are able then to get the necessary diameter of the stack.

To get the height of the stack we refer first to the curves showing the draft required between furnace and ashpit for various kinds of coal. Here again we must assume the kind of coal that will be used and also the pounds of coal that will be burned per square foot of grate surface per hour when the boiler is being pushed which will be about 60 per cent more than for normal rating. We then are able to find from the curve the draft required between the furnace and the ashpit. To the draft required between the furnace and ashpit must be added that necessary to pass the gases through the boiler and setting, these values are found in the table for Draft Through Boiler Setting. Then allow 0.1 in. for each 100 ft. length of flue and 0.05 in. for each right angle bend of the flue and add all these resistance together and the result will be the draft required in inches of water.

Referring now to the chart showing the theoretical draft power of chimney and, assuming the temperature of the stack gases, the height of the stack can then be determined.

To illustrate the method by an example let it be desired to find the dimensions of a brick stack which will take care of the gases from a battery of boilers with a rating of 1500 hp. using run-of-mine semi-bituminous coal which will evaporate 9 lb. of water from and at 212 deg. per pounds coal. The length of flue is 50 ft. and has one right angle bend.

Following the course outlined above we find from the curve for diameter of chimney at sea level that for a brick stack taking care of 1500 hp. the diameter must be 90 in.

It is next necessary to find the combustion per square foot of grate surface. Assuming that 3 lb. of water will be evaporated per hour for each square foot of heating surface and a ratio of 40 to 1 between the heating surface and the grate surface, the normal rating of the boilers would be $40 \times 3 \div 9 = 13.3$ lb. of coal for each square foot of grate surface. To push the boilers to 50 per cent overload this will be increased by about 60 per cent or 21.28 lb.

Refer now to curve No. 5 given under the heading Draft Required Between Furnace and Ashpit for various kinds of coal and corresponding to 21.28 lb. of coal burned per square foot of grate surface will be found the draft required which is 0.22 in. of water. To this is added 0.18 to take care of the gas under the boiler and through the tubes, 0.12 for retarder such as soot, 0.06 for the pass over the boilers, all of which are found in the table for Draft Through Boiler Setting, then allowing a drop of 0.1 per 100 ft. of flue gives 0.05, and 0.05 for each right angle bend make a total resistance of $0.22+0.18+0.12+0.06+0.05+0.05$ or 0.68 in. water.

Assuming that the gases discharge at 55 deg. F. and referring to the curves for the theoretical draft power of chimney we find that we require a chimney about 95 ft. high or practically 100 ft. The stack to accomplish the desired results is then 90 in. internal diameter and 100 ft. high.

INVESTIGATIONS HAVE BEEN carried on by the Bureau of Mines in regard to briquetting of lignite and results of these are reported by Chas. L. Wright, in Bulletin 14, of the Department. He states that the tests indicate that some lignites can be made into briquets on a commercial scale without using any binding material. A sample from Texas, one from North Dakota and another from California were thus worked satisfactorily. It was found that in some cases the exposure of the lignite so that it was partly slacked, made it easier to work. Tests for cohesion and weathering indicated that good briquets will endure handling and resist weathering much better than the lignite from which they are made.

These tests apparently show the cost of briquetting lignites with a German plant, such as was used, to be from $1.35 to $1.75 a ton, according to location. The cost of briquets per ton loaded on cars would be in Texas $2.51, in North Dakota $3.53, and in California $5.34. These are only approximate figures and may change widely because of local conditions. Briquetting not only puts the lignite in durable form for handling, but also expels a large part of the moisture, ranging from 24 to 38 per cent, thus making the heating value of the briquet higher than that of the fuel. The bulletin in full can be obtained by writing to the Director of the Bureau of Mines, Washington, D. C.

PRINCIPLES AND ECONOMY OF REFRIGERATION MACHINES*

By Heywood Cochran

FIRST BROUGHT OUT by Carre of France, although Dr. Gorrie in this country was trying experiments along the same line at the same time, the absorption system is the oldest method of making ice. The first commercial absorption ice plant was a 4-ton Carre machine imported from France and originally installed at Savannah, Ga., but later moved to Shreveport, Ala., where it was put into commercial operation in 1866 by a Frenchman named Putz. One of the engineers of this plant was J. M. Cooper, who is still living in Shreveport.

The freezing tank contained only 30 20-lb. blocks, the dimensions of which were 2½ by 8 by 20 in. To make 4 tons of ice they had to pull 400 of these blocks, and as there were only 30 in the tank each block had to be pulled 11 times during the day in order to make capacity. In other words, it took only a little over 2 hr. for these blocks to freeze. Raw-water ice was made although no attempt was made to have it clear. This ice was readily sold for 5c a pound or $100 a ton, which is rather different from present prices. Mr. Cooper states that his salary in 1870 was $175 a month, which was doing pretty well for a 4-ton plant.

Principles of Operation

ANHYDROUS ammonia, the same liquid used in compression machines, is used in the absorption system. The difference between the absorption and compression systems consists in the method of freezing the expanded gas and making it a liquid again. In the compression plant this is done by a suction and compression pump, the gas being compressed into the condensers where it is liquified. In the absorption system, the strong attraction existing between ammonia gas and water is made use of. For instance, one part of water at 50 deg. will absorb 900 parts of ammonia gas per volume, while at 100 deg. it will absorb only a little over ½ as much. It is for this reason that, with cold well water, the surfaces of the absorption machine can be smaller than where the water is warmer.

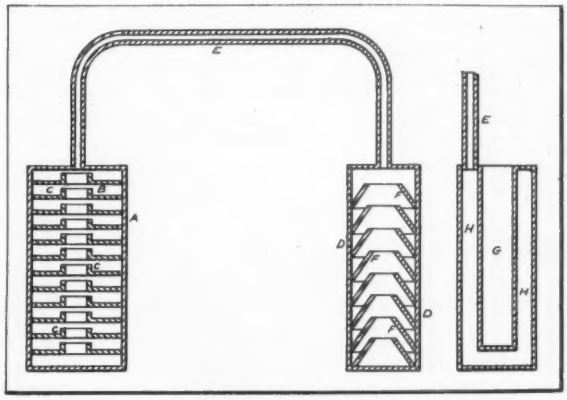


FIG. 1. CARRE'S ABSORPTION SYSTEM

Heat is produced when the gas is absorbed, called the heat of absorption. Cooling water must, therefore, be used in the absorber to remove this heat due to this chemical action. The combination forms aqua ammonia, which is the same aqua ammonia that you buy in a drug store, although somewhat stronger. If you were to leave the cork out of a bottle of aqua ammonia it would soon lose its strength, and if you were to put the bottle on the stove the gas would be driven off just that much faster. If you put a pipe through the cork and the bottle would stand the pressure and this pipe lead to the condenser, the gas driven off could be liquified just as in a compression plant.

In Carre's system, the original patent drawing of which is shown in Fig. 1, A was alternately the gen-

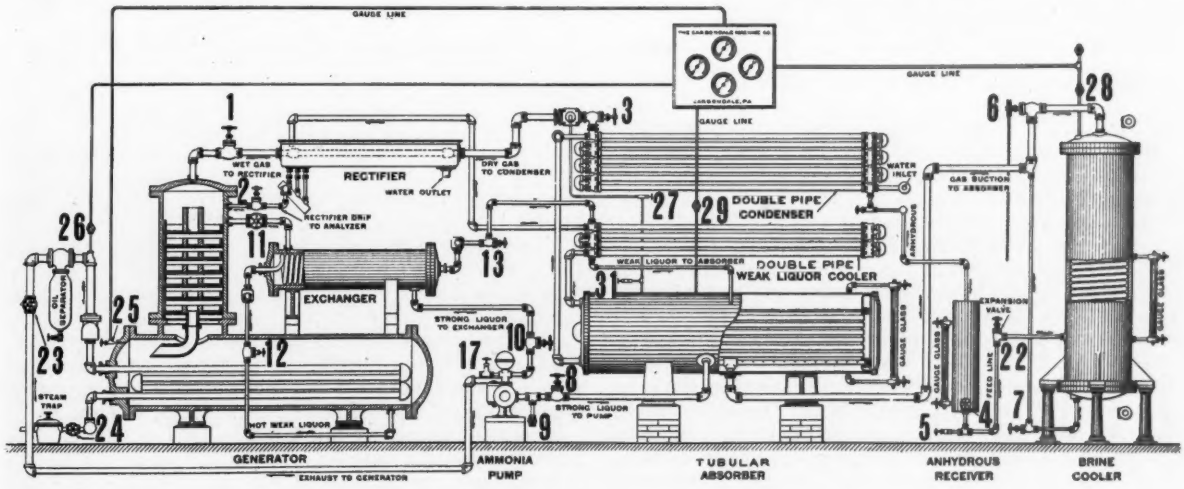


FIG. 2. RETURN DOUBLE PIPE AND TUBULAR TYPE MACHINE

*Abstract of an address before Illinois No. 1 N. A. S. E.

erator and absorber, while D was the condenser. After the gas was liquified it was allowed to expand through E, freezing water in the can G. Weak aqua was left in A, and when it was cooled off served as an absorber and the expanded gas from G was absorbed and made strong aqua again to be driven off with heat when A changed into a generator. It will readily be seen that this could hardly make a commercial ice plant, as the vessel A had to be alternately heated and cooled and the process was not continuous.

The double-pipe condenser, shown in Fig. 2, is the same as in the compression plant. The ammonia gas is condensed and passes through to the liquid receiver. The expansion valve is also the same as is the shell type brine cooler, shown on the right.

As previously stated, the point of difference comes in where the expanded gas leaves the brine cooler through the return gas line. Instead of being sucked out by the suction and compression pump, it is allowed to expand through a perforated pipe into the bottom of the absorber, which, in this type machine, is built

FIG. 3. ABSORBER WITH HEAD REMOVED

like a horizontal tubular boiler. Figure 3 shows a Carbondale absorber with the head removed. Cooling water passes through the tubes, the ribs in the head causing the water to pass 6 times back and forth. Weak aqua ammonia enters the absorber at the top and fills the space between the shell and the tubes. The ammonia gas passes through a perforated pipe at the bottom and bubbles up through this bed of weak aqua and is absorbed as fast as it enters, the cooling water through the tubes removing the heat of absorption.

As I stated previously, the ammonia gas in the aqua can be driven off by heat. The pressure in the absorber is usually carried at about 15 lb., while in the generator will be anywhere from 110 to 180 lb., depending upon the temperature of the condensing water. It is, therefore, necessary to pump strong aqua from the absorber into the generator and the small pump for that purpose is the only moving part about the system, this corresponds to a boiler-feed pump.

As this strong aqua is as cold as we can get it, in order to produce the amount of steam needed in the generator coils to drive off the gas, it is advisable to heat this strong aqua as much as possible before it enters the ammonia boiler, just as you heat boiler-feed water for a boiler. The strong aqua is, therefore, pumped through the exchanger, which is the feed-water heater of the system. Instead of using exhaust steam for heating, the hot weak aqua is passed from the bottom of the generator under its own pressure back to the absorber through the coil in the exchanger, while the strong aqua passes between the shell and the coils. In other words, the hot weak aqua heats the strong cold aqua and vice versa.

The heated strong aqua passes from the analyzer pans down into the generator, where its level is kept just above the steam heating coils. The gas driven off passes around the pans in the analyzer but does not come in actual contact with the descending strong aqua. This gas may contain a certain amount of moisture and it is necessary to dry it before it goes to the condenser. It passes first to the rectifier, this is merely a preliminary condenser where the temperature of the condensing water is sufficiently high so that at the pressure carried the moisture in the gas

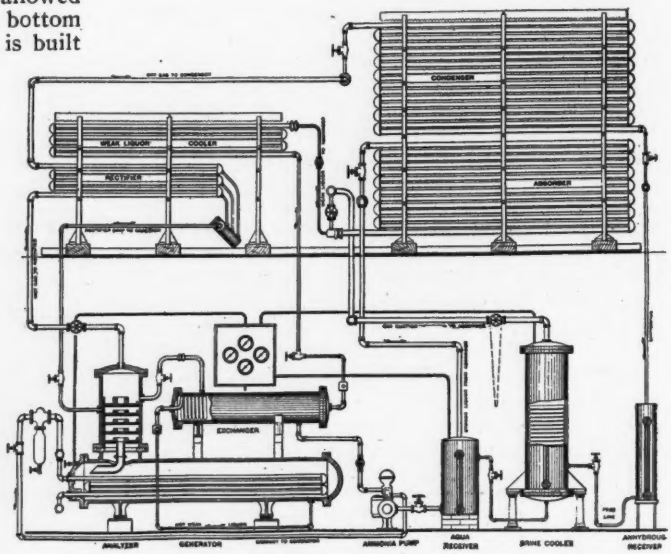


FIG. 4. ATMOSPHERIC TYPE ABSORPTION MACHINE

is condensed, but the gas itself is merely cooled. This moisture passes down through the drip bottle back into the analyzer. The dry gas passes on to the top of the condenser, where it is condensed and liquified.

To return to the weak liquid, after passing through the exchanger we usually cool it further in the double pipe weak liquor cooler, as shown, before it goes to the absorber to be made into strong liquor.

In the compression system there is only one cycle, that of the liquid anhydrous ammonia and ammonia gas. In the absorption system we have not only this cycle, but also that of the strong and weak aqua.

Figure 4 shows an atmospheric type machine. The principle in this case is exactly the same as in the double pipe and tubular type. In this case, the gas and weak aqua enter through a mixing device at the bottom of the absorber. The condenser is usually placed immediately above the absorber, so that the cooling water which passes over it can be used for the absorber. The strong aqua passes down to the aqua receiver and is then pumped through the exchanger into the generator as before.

From the description it will be seen that in the absorption process the heat of the steam is used, but very little of its expansive force, as the aqua pump requires only about 1/20 hp. per ton of refrigeration.

The steam can, therefore, be used first in the water, boiler-feed, brine and aqua pumps or engines for power purposes and afterwards its heat used in the generator. The steam is actually condensed in the generator and becomes distilled water. In an ice plant, this distilled water is frozen into ice, while in the refrigerating machine it is returned to the boiler. The following table shows what becomes of the heat in a pound of coal. With coal having 13,500 B. t. u. only 1273 B. t. u. can be used in an engine, all the balance or over 90 per cent being wasted. About 1/3 of this loss is due to flue gases passing up the stack, but 7737 heat units or more than ½ is lost in the exhaust. Of course, a small portion of this, say 15 per cent, can be saved in a feed-water heater. In the exhaust steam absorption machine not only can we use the 1273 heat units for power purposes, but we can also use all of the 7737 lost in the exhaust.

Distribution of Heat from Pound of Coal.

Lost in ash	135	B. t. u.
Lost in radiation from boiler	675	"
Carried off in gases	2970	"
Carried off in auxiliary exhaust	190	"
Lost in radiation and leakage, main pipes	210	"
Lost in radiation and leakage, small pipes	30	"
Lost in radiation and leakage, engine	280	"
Rejected to condenser (Exhaust steam)	7737	"
Total loss	12227	"
Converted to power (Used by compression machine)	1273	"
Value of coal	13500	"

Comparison of Capacities

IN both cases, taking 170 lb. condensing pressure and 15 lb. suction pressure as unity, with zero suction pressure, a compression machine loses 57 per cent of its capacity with the same condensing pressure, while the absorption system loses only 6 per cent. When the suction pressure is 30 lb., however, the compression machine gains 56 per cent, while the absorption system gains only 5 per cent. It is, therefore, apparent that the capacity of an absorption machine varies much less than that of a compression machine with a different suction and condensing pressure. This can be easily understood when it is remembered that the cylinder volume of the compression machine is the same at all times while an absorber of the absorption machine will absorb almost as much gas at low pressure as at high.

Figure 5, a reproduction of curves given by Gardner T. Voorhees, shows the steam consumption of the simple compression machines, condensing compression machines and simple absorption machines per ton of refrigeration per hour. Here it will be noted that the absorption machine excells the simple compression machine at all stages, while the compound condensing compression machine gives better results than the simple absorption with higher back pressures. The suction pressure where the curves cross is about 10 lb. for 200 lb. condenser pressure. This, however, does not include the steam for the auxilaries. When this is taken into account and the exhaust steam absorption machine is used the results obtained surpass those for the compound condensing compression machine.

Relative Coal Consumption

THE number of tons of ice per ton of coal that can be made by various machines is shown in the following table from Voorhees' book on Refrigerating Machines. The boiler evaporation in this case is taken 8 to 1. These figures were made for plate ice and not for distilled water can ice. An exhaust steam absorption machine can, however, make 13.3 tons of ice per ton of coal, where the exhaust from the pumps is used in the generator. If the exhaust from the compound compression machine is used in the generator of the absorption machine, 16 tons can be obtained.

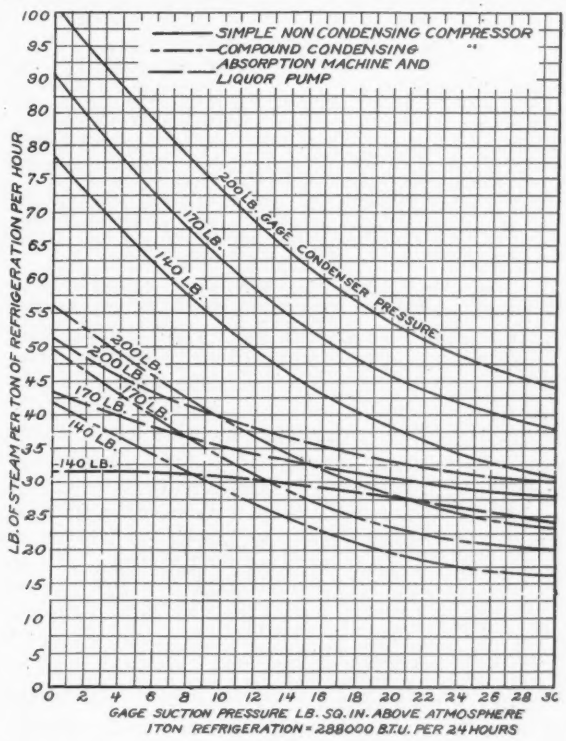


FIG. 5. STEAM CONSUMPTION OF DIFFERENT TYPES OF MACHINES

Comparison of Coal Consumption by Various Machines

	Net tons of Ice per ton of Coal	% of Ice by Absorption Machine
Compression, simple Corliss engine, non-condensing	6.1	.....
Compression, compound Corliss engine, non-condensing	8.3	.....
Absorption, liquor pump and auxiliaries, not exhausting into generator, simple non-condensing engine	10.0	.....
Compression, compound condensing engine	11.2	.....
Absorption, liquor pump and all auxiliaries exhausting into generator, simple Corliss engine, non-condensing	13.3	.....
Compression and absorption, simple Corliss engine, non-condensing.	13.4	67.5
Compression and absorption, compound engine, non-condensing	16.0	60.8

There is no doubt about the fact that there is a big field for the exhaust steam absorption machine in enlarging existing compression plants. A study of the curves in Fig. 5 will make clear that just as the exhaust steam turbine combined with a compound reciprocating engine makes the most economical arrangement in existing plants that require more power, so does the absorption refrigeration machine prove most economical where exhaust steam is available for heating the generator.

PRACTICAL ENGINEER

PUBLISHED ON THE FIRST OF EACH MONTH
At 537 S. Dearborn Street, Chicago, Ill., by the
TECHNICAL PUBLISHING CO.
New York, 150 Nassau St. Philadelphia, 524 Walnut St.

Subscription Price One Dollar a year in advance to any Post Office in the United States and Mexico or United States possessions.
To Canada One Dollar and Fifty Cents; to Other Countries Two Dollars a year. Single copies 10 cents.
Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago, Ill. Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 22,500.

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ENGINEERING AND THE GAS ENGINE

At the recent meeting of the National Association of Gas and Gasoline Engine Trades, there was a lively discussion in regard to the needs of engineering equipment of gas engines. Two papers in particular were devoted to the importance of proper ignition to the successful operation of the internal combustion engine, and emphasized the need of securing a magneto or battery suited to the particular work which it has to do.

Mr. Oglesby said right out in meeting that a good magneto, not suited to the engine is as bad as a poor one, and called attention to one case where a magneto was ordered, without any specification as to what it had to do, and later the buyer stated that it had been found on careful test that a certain voltage, current and speed best fitted the needs of the engine.

Another engine builder was trying to supply ignition current for 5 2-cylinder engines at one time, all from a single magneto, and then kicking because the magneto would not come up to the work. The great lack of common sense which aside from reliable test data is the chief ingredient of good engineering, seems to be fully illustrated by these 2 cases, and the fact that those engaged in the business are beginning to realize the need of this engineering, and apply it, speaks well for the future rapid elimination of many troubles, so-called, which have heretofore hindered the popularity of such engines. The same argument applies to battery equipment as was brought out by Mr. Combs in his paper. Furnishing a battery which is too weak to give the needed spark, leaving a battery for a long time unused until it has "died," putting in a storage battery with plates of too small capacity for the needed current, or, what amounts to the same thing, over-rating the capacity of a battery, all these were condemned as poor engineering and as being responsible for many cases of mistrust.

A carefully insulated wire for ignition badly placed, came in properly for its share of disapproval. An incident to the point was the experience of the writer recently on a standard well built make of automobile, in which the wires leading to the timer were so placed that the unmechanical owner of the machine had literally soused them in oil and grease, so that 3 of the 4 circuits were short circuited, and a 4-cylinder engine was thumping along on a single cylinder, the other 3 cylinders not getting enough spark to ignite the charge. Mr. Combs says: "Give them good wire with good new rubber insulation, with a good grade outside cover, impregnated with an oil and water proof compound. Tell them how to protect it further by putting it where it will be high and dry, and you will put out the chance for lost power or failure from that cause."

Good engineering means quite as much good insulation and proportioning of the different parts of a power plant as it does good design of the dimensions of the engine or other prime movers, and the same necessity for good engineering applies whether the power plant be a one horsepower engine for a farm, a 30 horsepower for an automobile or motorboat, or a 30,000 horsepower for a big central station.

WHY LICENSE LAWS?

A man has a right to his opinion. That statement is surely old enough to go without challenge. And it is almost equally certain that of a dozen men no two will quite agree on all questions, so that it is natural that several ways of thinking exist not only as to what should be in a license law, but whether there should be one at all.

Life, liberty and the pursuit of happiness have been stated as our inalienable rights. The last named may be hard to catch, but we have a right to keep moving. It's the business of government, so far as possible, to protect the citizens in these rights, and protection to life is recognized in our laws as to the storage and use of explosives, firearms, inflammable material, and poisons. Protection against dangerous ignorance is practiced in the control of doctors, lawyers, druggists, plumbers, marine engineers.

The case of the steam plant and electric plant seems to partake of both these; an unsafe boiler or engine is as dangerous as gunpowder; and ignorant or careless handling of steam machinery or high voltage electricity is surely as fatal to the "innocent bystander" as is escaping sewer gas.

In this issue, recently proposed laws are summarized and a correspondent enters his protest against the tendency of examinations. The main argument seems logical, that it is no business of the state to determine a man's ability to operate a plant efficiently; only to determine whether he can operate it safely.

Without doubt, some questions given in examinations cannot well be accounted for, and some examiners overstep their bounds of reasonable authority; but it is difficult to determine the safety of a man's engineering knowledge without asking questions which will also determine his effectiveness. There are several things besides a burned furnace sheet which may cause a boiler explosion, and a broken governor belt is not the only reason for a runaway engine and ruptured flywheel.

A plant kept in effective and efficient operation is likely to be in safe condition, while a plant allowed to "run down at the heel" is likely to have weak spots which invite disaster.

Examination on correct design of machinery would not seem to be allowable except so far as safety against legitimate strains is concerned, but of these, the engineer should know if he is to be able to safeguard his plant.

Experience, again, is an important point, in safety as well as in efficiency, for a man who is to be responsible for machinery. Accidents are more likely to occur at some time of emergency than in the ordinary running of a plant, and ability to think and act quickly and wisely during emergencies comes only from familiarity with all sorts of equipment under all sorts of conditions.

Considering that the reason for a license law is primarily protection to the public, catch questions, computation of efficiency and power developed and economy are not legitimate parts of an engineer's examination; but as a matter of fact it would be difficult for an examiner to question an applicant sufficiently to determine his fitness to safely care for a complicated plant, without, in the course of the examination, getting quite a definite idea of his ability to handle such a plant economically.

POWER AND THE FARM

To do anything on a big scale requires power; not only mental power and ability to think big things, but mechanical power which makes possible the accomplishment of such things. The present day methods of farming require large application of power, as was strikingly shown in a recent paper by Prof. J. G. Waggoner, of the Service Bureau of the International Harvester Co. Calling attention to the fact that the export trade in farm machinery for the month of March 1910 alone amounted to millions of dollars, he said that this is only a small part of what must be produced for the use of the farmer if the needs of the world in the way of food products are to be met.

So far the chief uses of power have been for manufacturing and transportation, but with the development of the big farm it becomes necessary to have machinery which can handle cultivation and transportation of farm products on a big scale. In all cases where big business, that is business done in a big way is possible, it is because of the application of power to the processes involved. The American farmer has been badly handicapped by the insufficiency of machinery to meet his needs. This is now being met in part by the use of the tractor, and the stationary pulling engine, which enables one man to direct the energy, which in the former animal power required the services of many men.

Dr. Knapp has stated that the products of the Southern States could be increased 800 per cent by the application of modern methods of agriculture, that is, by the application of power to farming operation. Also that the extension of dry farming which is to make available a great part of the semiarid lands in the west, demands the use of machinery by which one man can cultivate 10 acres instead of one so that rapid cultivation may be possible after the rather infrequent rains. By such quick cultivation the yield can be increased from 50 to 100 per cent.

We are familiar with the adaption of the gasoline engine for the convenience of the farmer, but this new idea implies that the power engineer is the one to which the coming generation must look for increasing the available food supply as will be necessary to meet the increasing demand of the growing population of the earth.

A novel suggestion is that of the establishment of a bureau of power and farm machinery in the Department of Agriculture, for the testing and approval of farm apparatus in the same way that other problems in regard to farming are now handled by the department.

In a paper on an allied subject by E. E. Edwards, the need of engineers, who are experts on farm machinery and on the uses of power for farm work, to advise farmers as to the proper machinery for them to install for a given line of work, and also to decide on the amount of power needed, the proper engine, tractor, motors and other devices was emphasized and the lack of power engineers who have such knowledge and are properly qualified to give the farmer good advice along this line was brought out as offering a field which will rapidly increase in importance with the adoption of large machinery for farming purposes. Those who meet this need quickly will be the ones to reap the reward.

CONNECTICUT ENGINEERS' CONVENTION

A BOOM FOR LICENSE AND EDUCATION

THERE have been many larger state conventions than that which assembled in Phalanx Hall, Hartford, on June 23 and 24, but it is safe to say that in none has there been shown a greater spirit of enthusiasm for the cause or a more general and earnest participation, by the delegates, in discussion of the subjects presented for consideration.

The first day of the convention was devoted mainly to the inspection of the engine room apparatus, attractively displayed in decorated booths by the various supply houses and manufacturers. The exhibition was fully up to the high standard established in previous conventions by the hustling representatives of the supply trade and drew a large attendance of interested visitors from the opening to the close of the convention. Friday evening was set apart for social entertainment and when the exercises began at 8 o'clock an audience, including a number of the ladies, filled every seat and occupied much of the standing room in the exhibition hall. The meeting was called to order by President E. H. Ostrander, of the Connecticut Association, who briefly introduced Hon. Edward L. Smith, Mayor of Hartford, as the first speaker of the evening.

Mayor Smith extended a cordial welcome to the visiting delegates and courteously emphasized the fact that in coming to Hartford they were still at home, since it was their capital city, and contained among its most notable features many important edifices and institutions provided by and belonging to the people of all the state.

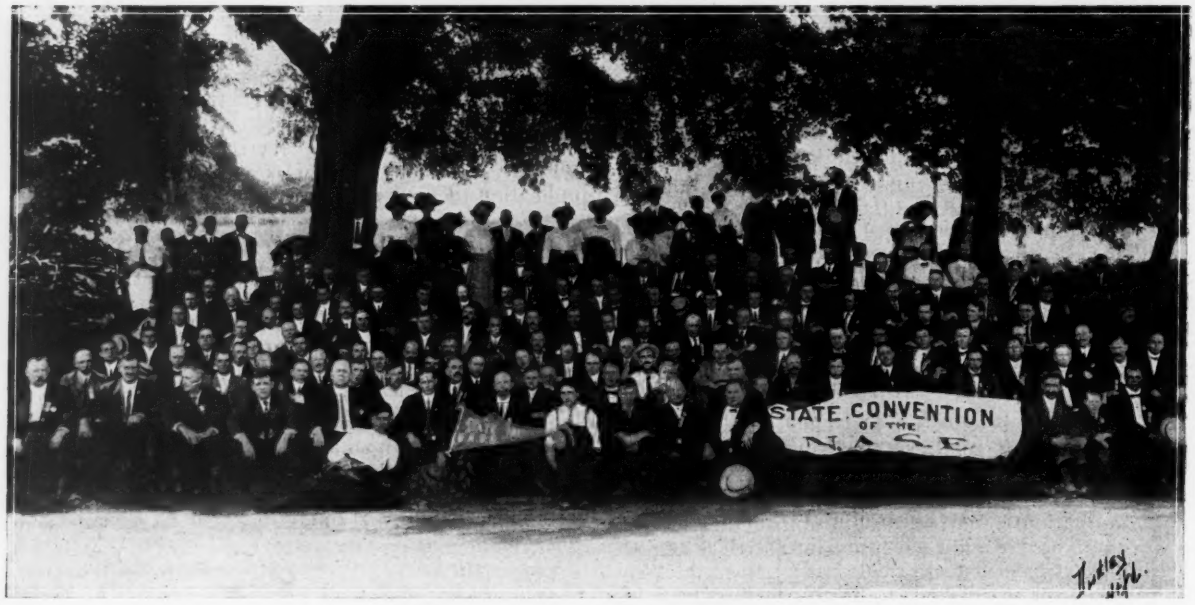
He spoke of the highly important part borne by the engineer in our present social industrial and commercial life and of the engineer's right to be protected by adequate legislation.

Edward H. Kearney, of Boston, National vice-president, responded and voiced the appreciation and thanks of all the delegates assembled. He said that he regarded as specially significant and important the expression of belief by Mayor Smith in the imminence of license legislation. He then briefly recounted the progress of the association and counselled the engineers to continue their successful course of active loyalty to its principles and purposes.

Following this address, a vaudeville entertainment was provided by the supply men and was greatly enjoyed by those present. The following artists took part: Billy Murray, of Jenkins Bros.; James Sevine of The Peerless Rubber Co.; Frank Carbit, of The Consolidated Safety Valve Co.; Jack Armour, of Power and Edward Keefe, of Hartford.

Saturday Sessions

ON Saturday the delegates assembled in regular session at 9 a. m., with President Ostrander in the chair, and for 3 hours matters pertaining to the good of the order received alert attention and careful consideration at the hands of the convention. Of the business transacted, the principal features were, the nomination and election of officers for the ensuing year;



THOSE IN ATTENDANCE AT HARTFORD

appointment of a state committee on education which should initiate and promote educational activity among the smaller organizations throughout the state so that such organizations might be enabled to keep pace in educational progress with those located in the larger industrial centers; and the appointment of a committee to act as representatives of the order in an effort to secure by all lawful means the enactment of a license law in Connecticut.

Officers elected for the coming year are: F. L. Chapman, of Norwich, president; F. H. Phillips, of Hartford, vice-president; William J. Blacker, of Waterbury, secretary and treasurer; Thomas Reed, of New Haven, conductor; Harry Heakley, of New Haven, door-keeper; P. J. Grace, Bridgeport; B. Holt, New Haven, and George M. Thomas, trustees; and for state deputy, T. M. Hastings, of Meriden.

Among the notable addresses at the session was one by Past President H. E. Stone, in which he strongly commended the objects and efforts of the Ladies' Auxiliary, and that of Past President H. Hogan, who counselled the adoption of a plan to enable isolated engineers to affiliate with and enjoy the benefits of the order.

On Saturday afternoon an excellent clam bake was enjoyed by the delegates and supply men and a number of their ladies at Newington. Previous to the serving of the clam bake a game of baseball was played between representatives of engineers and the supply men which was won by the engineers. The victors received a handsome pennant amid hearty plaudits from their late opponents.

The Exhibitors

AS usual the interest and success of the convention was largely due to the character and variety of the supply exhibits as well as to the genial personal qualities of the competent gentlemen in chage of them.

THE HARTFORD STEAM BOILER Inspection and Insurance Co. had an exceedingly vivid and suggestive display of remains from, and photographs of, results of boiler explosions. C. D. Francis, a veteran inspector of the company was in charge.

BALDWIN AND STEWARD CO., of Hartford, had a line of electrical goods including electric fans, motors, lights, etc. A working model of the Hylo light indicated clearly the possibilities of economy by use of the contrivance. W. H. Welch was the representative.

THE LONG GRATE BAR CO. had a display of its duplex shaking grate. Though comparatively a new product, it has already met with a large patronage in New York, New England and the West. General Manager R. T. Stafford was in charge.

THE H. W. JOHNS-MANVILLE CO. had a large display of its reliable and popular packings. The "Absolutely automatic packing," which effectively overcomes variations in point of contact, was a notable feature of the exhibit and was closely studied and admired by the visiting engineers.

THE TRAVELERS INDEMNITY CO., and Travelers Insurance Co. had a large collection of exhibits showing dangerous conditions in elevator cables, and other apparatus, which had been discovered in the course of inspections, also some remarkable effects of explosions in stationary and marine boilers, explained by L. H. Brown, who was in charge; the exhibit was deeply interesting and instructive.

THE HARRISON SAFETY BOILER WORKS had an extensive exhibit of its apparatus and was represented by its agents F. E. Idell and W. W. Mantolos, Jr. In conjunction there was a display of feed pumps, water heaters and separators, by the M. T. Davidson Co., represented by Wm. E. Brennan.

THE ASHTON VALVE CO. exhibited a fine line of high class goods including steam safety valves, water valves, gages, steam whistles, etc. W. E. Brennan representing the M. T. Davidson Co., is handling the products.

THE MASON REGULATOR CO., of Boston, also showed a large line of steam regulating appliances. F. A. Morrison and W. J. Kennedy were in charge. The display was attractive and impressive.

CHARLES A. CLAFLIN & CO. exhibited tube cleaners and Sure Hold Hose Fittings as their leading specialties. Chas. A. Clafin was on hand to describe the merits of the goods.

GREENE-TWEED & CO. had a large and varied display of Palmetto Packing.

THE WELDING EQUIPMENT CO., of Hartford, had an interesting exhibit which included an effective demonstration of their Oxy-Acetylene process by J. L. Tucker, the company's representative.

WILLIAM R. WINN, of Bridgeport, showed an extensive line of packings, lubricating oil, and grease. E. L. Berge was in charge.

THE CONNECTICUT METAL BOILER Cleaning Co., exhibited a new process of cleaning boilers from scale by suspending small spheres of metallic composition in the boiler. B. N. Kirkham explained the wh".

THE HARTFORD MILL SUPPLY CO, had an elaborate display of mechanical supplies for factories. Its exhibit of metallic steel hose, was specially noticeable. A sample of "voice tubing" fifty feet long and twisted into a number of coils was shown to possess remarkable power of enabling the slightest whisper to be heard throughout its entire length. N. D. Merwin was in charge.

JENKINS BROS., whose display is always a prominent feature of engineer conventions, were represented on this occasion by R. H. Stiles and G. E. Hodgkin who kept a crowd of engineers constantly interested in examining the exhibit of high grade valves and packing. The display included Overland Sheet-packing and a full line of medium pressure and heavy gate valves and Donnelly vacuum valves.

THE GENERAL ELECTRIC CO. through its New Haven branch office made a striking exhibit of electrical supply goods. The special features were recording steam flow meters, electric motors and Mazda lamps. L. H. Lewis, manager of the New Haven office, was on hand to interest and entertain the visiting engineers.

W. J. HYLAND MFG. CO. had a line of valves, faucets, blow-off cocks and drinking fountains; special exhibit was made of the Bashlin Valves. W. J. Hyland and J. J. Kirby were in attendance.

W. R. HANCOCK, New England Manager, was the representative for the D. T. Williams Valve Co.

FOR THE HOME RUBBER CO., A. R. Foley, manager, showed a line of rubber goods for all purposes in the power plant.

THE UNIVERSAL LUBRICATOR CO., of Philadelphia, through the W. R. Winn Co., displayed an extensive line of lubricating goods, including Winout Caster Oil, stick belt dressing and packings. A quantity of instructive literature as well as competent exposition of the merits of the goods were dispensed to visitors by the representatives J. B. Harrington, F. B. Driscoll and George Maher.

NIGHTINGALE AND CHILDS, of Boston, exhibited a line of asbestos products and other supply goods. A specal feature was made of the Swartwout rotary ball bearing ventilator. F. H. Shute represented the company and H. H. Lind the Ohio Blower Co.

THE RED STAR SALES CO., of New York City, through its hustling and popular manager and treasurer, W. F. Hogg, had an extensive and effective display of their products.

THE LUNKENHEIMER CO., of Cincinnati, had an attractive display of engineering specialties, which included a large assortment of valves, steam whistles and lubricators. This booth was one of the centers of attraction during the convention and was competently cared for by James A. Sampson.

THE KEYSTONE LUBRICATING CO. was in the front row with a fine display of Keystone greases. They capped the climax by presenting the visiting engineers with neat head coverings suitable for use in the plant. F. Waldo Gordon represented the company.

THE AMERICAN STEAM GAUGE AND VALVE CO., in a well filled booth, displayed valves, gages and indicators. W. H. Nixon was in charge.

C. S. MERRIE & CO. exhibited a line of mill supplies including lubricating apparatus, tube cleaners and packings. C. H. Albree and H. M. Glynne were the representatives.

THE ROTO CO., of Hartford, had a working exhibit of the Roto Tube Cleaner on exhibit which aroused considerable interest among the visiting engineers.

THE PERFECTION GRATE CO. made an effective demonstration of the value of their product through William L. Cronin.

THE BOOTHS at either entrance to the exhibition hall were occupied respectively by Power and Practical Engineer. C. W. Debble and Jack Armour represented Power.

THE PRACTICAL ENGINEER was represented by Joshua O'Leary and J. B. Kershaw.

At a business session of the supply men's association the present officers were re-elected to serve for the ensuing year as follows F. S. Bulkley, president; R. H. Stiles, secretary and treasurer; executive board, F. P. Upson, J. H. Foote, J. B. Harrington.

THE ENGINEER'S APPLIANCE CO., of Cleveland, Ohio, has been incorporated for the purpose of manufacturing and selling steam and water appliances and has taken over the valve business of the Cleveland Steel Tool Co., including patents, finished drawings and stock relating to the Hydromatic water control valve. The sale of this valve will be pushed beyond the already considerable volume which it has reached and new specialties will be brought out from time to time. The address of the company is East 82nd St. and Lake Shore Railroad, Cleveland, O.

IN THE HEART OF THE COMMONWEALTH

MASSACHUSETTS ENGINEERS, WORCESTER, JULY 13-15

ANNUAL state convention of the Massachusettts National Association of Stationary Engineers this year had a most auspicious environment. It was held in the second largest city of the state, and in Mechanics Hall, which is not only the largest and finest in the city, but is also of historic interest in the city's social and political life. The building in which the hall is located is situated on Main Street in the center of the business section and is owned by the Worcester Mechanics Association. It contains a large and valuable library of mechanical works and is one of the institutions of which Worcester is justly proud.

At the opening of the exhibition on Thursday, the entire space of the main floor was occupied by the gaily decorated booths, in which engineers and mill supply houses from various manufacturing centers all over the country, displayed their products in most attractive and instructive form.

BOOTHS AT WORCESTER

Welcome to Worcester

AT 10 o'clock on Friday the delegates assembled in the lower auditorium, called Washburn Hall, after one of Worcester's most noted and successful mechanics, and listened to a cordial and appreciative address of welcome by Mayor Logan, who is not only the honored chief executive of the city and now serving his fourth consecutive term in that capacity, but is also the popular chief executive of one of the city's large manufacturing enterprises, the Worcester division of the United States Envelope Co.

Mayor Logan stated that in earlier years he was himself identified with the work of the stationary engineer. He briefly traced the tremendous influence on civilization and human welfare exerted by the development of the steam engine, eulogized the character of Watt, its inventor, as a man as well as a mechanic and indicated many reasons why the engineer should be proud of his calling and a valued member of the community in which he lives.

This address of the mayor called forth the enthusiastic plaudits of the audience which consisted of a large number of delegates from the Ladies' Auxiliary, as well as the delegates of the N. A. S. E.

President E. M. Woodward, of the Worcester Board of Trade, followed the Mayor and gave an interesting statement of Worcester's present population and industrial development. He showed by statistics comparison with other cities and sections of the country the remarkable aggregate of horsepower used in manufacturing industries by "The Heart of the Commonwealth of Massachusetts."

F. L. Johnson, associate editor of Power, spoke briefly and forcibly of the problems that beset the engineer today and pointed out that through the development of machinery and the specializing of methods in mechanical work, the engineer has come to be the last of the all-round mechanics in modern industrial life.

Mrs. Nella C. Moore, of Worcester, president of the New England Woman's Auxiliary, was called upon and was escorted to the platform by Past-president H. E. Stone. Her address, which was without preparation, was remarkable for its grace, felicity and effectiveness. At the close she received an ovation of enthusiastic and prolonged applause.

Other speakers were Past-president Stone and National vice-president E. H. Kearney.

At the close of the speaking, Chairman Lamb of the local committee of arrangements, turned the meeting over to state president G. L. Finch, of Boston, who on assuming the chair was presented with a silver mounted gavel made from a tree marking the geographical center of the state. The presentation was made on behalf of the State association by Past National President P. H. Hogan, of Boston, and a boquet of carnations was presented by Past-president H. E. Stone. After some routine business covering the appointment of committees the convention adjourned for dinner.

A New England Association?

AT the afternoon session many matters pertaining to the good of the association were considered and acted upon. Among them was the appointment of a committee to confer with members of the association in all the New England states regarding the formation of an organization to include all the New England states, which should meet in New England, instead of state annual conventions. The committee consists of the following members: T. N. Kelsey, Lowell; W. H. Sennet, Boston; J. M. Fadd, Boston; P. V. Terrill, Haverhill, and Thos. Ray, Cambridge.

New Officers

THE following officers were elected for the ensuing year: State Deputy, C. J. Wilder, of Worcester; president, James H. Sumner, of Cambridge; vice-president, John F. Maloney, of Fall River; secretary, Ole Peterson, Boston; treasurer, Walter H. Damon, of Springfield; conductor, A. F. Cheney, of Millford; doorkeeper, John H. Parker, of New Bedford. Northampton will be the meeting place next year.

In the evening the delegates and supply men enjoyed a "smoker" at Washburn Hall, in connection with which an enjoyable stage entertainment was given by artists from among the supply men.

New England Exhibtors Organize

AN important event in connection with the convention was the formation of an organization among the exhibitors to be known as The New England Association of Commercial Engineers with the object of cooperating with the members of the N. A. S. E. in preparatory work, and in management of local conventions. A constitution was adopted and the following officers unanimously elected to serve for one year: C. D. Allen, of Boston, president; Harry B. Allen, vice-president; Edw. L. Gruchy, secretary; H. B. Stone, Boston, treasurer; T. Adison Collins, Boston, Wm. M. Beal, Boston, Thomas P. Burke, Providence, and Gordon Hall, Boston, trustees.

Ladies' Auxiliary

THE Ladies' Auxiliary held its convention at Washburn Hall with a full and enthusiastic attendance. Mrs. Nella Moore of Worcester, president, was in the chair and conducted the proceedings. The following officers were elected for the ensuing year: President, Mrs. Ollie Heckler, of New Haven; vice-president, Mrs. Elinora C. Green, Chartley; secretary, Mrs. Dorothy Cole Rowe, of Waltham; treasurer, Mrs. Hannah L. Confield, Providence; conductor, Mrs. Carrie L. Bremer, Springfield; chaplain, Mrs. Herman Hallbuer, New Haven; doorkeeper, Miss May Hughes, Waterbury, Conn. A pleasant incident of the convention was the presentation by Mrs. Moore, on behalf of the delegates, of a past president gold pin to Past National President Mrs. Emma N. Stone, who was the first national president of the organization.

BOOTHS AT WORCESTER

Saturday for Outing

ON Saturday morning the engineers visited the Worcester Polytechnic Institute and the Worcester Trade School. At noon the delegates and exhibitors proceeded by special cars to Lake Park, on the bank

of Lake Quinsigamond, where a picnic lunch was served, and a handsome baseball pennant was contested for through an exciting game between nines representing the engineers and the exhibitors. The result was victory and the pennant for the engineers. After the game the party, which included the delegates of the Ladies' Auxiliary, proceed by steamer to the White City, where dinner was served and various amusements enjoyed until time to take cars for the return to the city.

Exhibits

DISPLAY of supply goods by the exhibitors was unusually extensive and varied and was a most important feature of the convention. The following firms were represented:

FEDERAL METALLIC PACKING Co., represented by H. W. Rand, C. M. Wheaton and W. H. Atkinson, displayed its special metallic packings.

ACKLEY & BRINK MFG. Co. was represented by Harold V. Brown.

WALTER C. RUGGLES Co., of Boston, exhibited power plant specialties.

CLING SURFACE made by the Cling Surface Co., of Buffalo, was displayed by Chas. G. Chase.

HILLS-MCCANNA Co., of Chicago, displayed force feed lubricators in charge of Robert E. Hills.

VACUUM OIL Co., of Rochester, N. Y., represented by Wm. F. Prizer, exhibited high grade oils.

CONNECTICUT BOILER CLEANER Co., of New Haven, showing metal boiler cleaners and water softeners, was represented by B. H. Kirkham and F. H. Loomis.

ECONOMY LUBRICATING Co.'s representatives were Jas. L. McCurdy and F. H. Loomis.

NIGHTINGALE & CHILDS Co., of Boston, represented by L. C. Parker and J. K. Park showed its line of asbestos goods.

PATTERSON LUBRICATING Co.'s oils and greases were displayed by Edw. String.

LAGONDA MFG. Co. showed its Weinland tube cleaners and Lagonda strainers and automatic valves in charge of W. J. Patterson.

AMERICAN OIL Co., of Providence, was represented by S. F. Babbitt and T. N. Griggs, showing a line of lubricating oils.

BISHOP & BABCOCK Co. showed electric and power pumps.

MCLEOD & HENRY Co.'s Steel Mixture arches, jambs and blocks were exhibited by John H. Foote.

PRACTICAL ENGINEER booth was in charge of J. O'Leary.

AMERICAN STEAM GAUGE & Valve Mfg. Co. showed gages and indicators in charge of A. W. Hobbs and W. H. Nickerson.

ALBANY LUBRICATING Co.'s representatives, M. V. Peary and W. D. Naughton, displayed Albany Grease, "all lubricant."

PERFECTION GRATES were shown by W. L. Cronin and N. J. Hibbard of the Perfection Grate Bar Co.

P. L. RIDER RUBBER Co., represented by A. E. Thompson, F. G. Trumbull, A. G. Adams, and Lewis Weidiman, had a line of rubber goods.

HUMIDIFIERS AND IDEAL steam traps were displayed by the Tillotson Humidifier Co., represented by Geo. Gray.

KEYSTONE GREASES for all purposes were shown by H. L. Carpenter and G. H. Mahan for the Keystone Lubricating Co.

GEO. W. KNOWLTON RUBBER Co. exhibited its sheet and ring packings in charge of W. L. Knowlton, E. H. Ochlof and Geo. W. Knowlton.

ENGINEER'S SUPPLIES and Chesterton's specialties were shown by H. D. Raymond and A. B. Park, representatives of A. W. Chesterton Co.

HOSE FITTINGS and tube blowers made by Chas. A. Claflin & Co., were in charge of Chas. A. Claflin.

BUILDERS IRON FOUNDRY showed Venturi hot water and steam meters in charge of C. J. Young Jr.

DEARBORN TREATMENT of feed water as practised by the Dearborn Drug & Chemical Works, was exemplified by P. H. Hogan.

NEW ENGLAND ENGINEER was represented by W. H. Beamon and E. F. de Grouchy.

HUDSON BELTING Co.'s representative was C. M. Bates.

SAMUEL DANIELS represented the Economy Instrument Co.

J. WING MFG. Co. showed Typhoon blowers, disk fans and feed-water regulators, in charge of H. W. Schofield.

POWER'S REPRESENTATIVES were C. W. Dibble, F. R. Low, F. L. Johnson, J. W. Armour, M. H. Reinhart, N. C. Robbins.

HART PACKING Co.'s sheet and ring packings were explained by H. Hart, V. C. Wheet and R. F. Hichborn.

PHILADELPIA GREASE Co. showed its greases and cups in charge of T. Addison Collins.

GARLOCK PACKINGS in sheet and ring form were shown by John V. Allen, Jas. Gayton, P. L. Rogers and C. D. Allen.

MANNING, MAXWELL & MOORE showed its valves, gages, indicators, injectors and other specialties in charge of H. B. Allen and F. J. Corbett.

GRATON & KNIGHT'S leather belts of all kinds were shown by J. Goodney.

W. R. WINN displayed a line of oils and greases and was represented by F. B. Driscoll and J. B. Harrington.

HOME RUBBER Co.'s N. B. O. line was in charge of Chas. F. Green.

BRAMAN DOW Co. had an exhibit of steam, gas and water specialties in charge of P. J. Henderson and Frank Ellis. It included a full line of Wm. T. Powell Co.'s valves.

ASHTON SAFETY valves and gages were shown for the Ashton Valve Co., by C. W. Houghton, H. H. Ashton, and Columbus Dill.

EAGLE OIL & SUPPLY Co.'s representative was C. H. Andrews showing oils, greases and steam specialties.

MASON REDUCING and regulating valves were exhibited for the Mason Regulator Co. by F. A. Morrison and W. J. Kennedy.

M. T. DAVIDSON showed samples of its line of steam pumps.

R. E. BROWNS arranged an exhibit of high grade gate valves for the Monarch Valve & Mfg. Co.

JOHNS-MANVILLE specialties including pipe coverings, packings and electrical devices and instruments were shown for the H. W. Johns-Manville Co. by W. T. Coppins, D. P. Wright, Geo. W. Esler Jr., D. C. Crosby and James Humphreys.

MECHANICAL CHAIN GRATE stokers were shown for the Ironworks Co. by H. M. Underwood.

FRICTION CLUTCHES of G. L. Fairbanks & Son were shown by E. L. Steel and G. L. Fairbanks.

UNIVERSAL OILS, greases and cups made by the Universal Lubricating Co. were displayed by H. W. Bishop.

PEERLESS RUBBER Co.'s full line of packings was exhibited by J. E. Stevens.

LUNKENHEIMER brass specialties made by the Lunkenheimer Co. were exhibited in charge of J. A. Simpson and W. W. Beals.

SOUTHERN ENGINEER'S representatives were L. L. Warren and F. Dobie.

THE 4S SPECIALTIES made by Strong, Carlisle & Hammond Co. were shown by Francis Evans and F. H. Evans.

AMERICAN METAL HOSE Co. showed Hose and hose couplings in charge of Geo. K. Gowan.

BURKE ENGINEERING Co.'s metallic packings were shown by Thos. P. Burke.

PACKINGS, GREASES and lubricators were displayed for the Lubron Co. by D. B. Wakelee.

F. E. RANSLEY represented Greene Tweed & Co., and exhibited steam and water packings.

CRANDALL PACKINGS, of the Crandall Packing Co., were in charge of Geo. H. Kendrick and E. A. Hare.

L. L. RICE represented the National Engineer.

POWER HOUSE accessories for economy were shown by the Elliott Co. in charge of E. L. Davis.

QUAKER CITY RUBBER Co.'s line of P. P. P. and other packings and rubber goods was in charge of H. A. Howe and John H. Barrow.

RAINBOW AND PEERLESS packings were shown by the Enterprise Rubber Co., represented by Chas. F. Heitzman, Gordon Hall and J. E. Stevens.

JENKINS VALVES and discs, packings and gaskets were shown for Jenkins Bros., by R. H. Stiles and J. E. Hodgkins.

OTHER FIRMS and representatives were: Autogenous Welding Equipment Co.; Mass. School of Engineering, T. L. Myers; Coats Clipper Mfg. Co., B. Austin Coates and H. V. Brown; New England Firm Cement Co., J. Henry Blanchard; Hinckley & Ramsay, A. S. Allen, Jr.; Reynolds Oil Co., A. N. Greenwood; Nelson & Shattuck, W. A. Nelson; W. J. Hyland Mfg. Co., J. J. Kerby and W. J. Hyland; Washburn & Garfield Mfg. Co., J. E. Washburn, Miles Standish, A. H. Paxon; Hartford Mill Supply Co., F. E. Upson, C. A. Sleeper; Max Machine Co., T. J. McNamara, M. J. McNamara, E. J. Magune; Geo. P. Anderson, H. W. Anderson and T. M. Gogin; Central Supply Co., H. C. Robinson, E. Dugan.

Power Apparatus

In Shop and Market

New Ideas in Making, Buying and Selling

HANDLING COAL IN A MODERN BOILER ROOM

PROBABLY no 2 boiler rooms in modern buildings present quite the same problems of solution. Conditions of location, space and requirements are such widely varying factors that the engineer is constantly called upon to devise new methods of adapting modern devices to suit his precise needs and yield the highest efficiency.

Of all the factors which govern him in reaching the solution of any given problem, none requires more serious consideration than the handling of coal. This

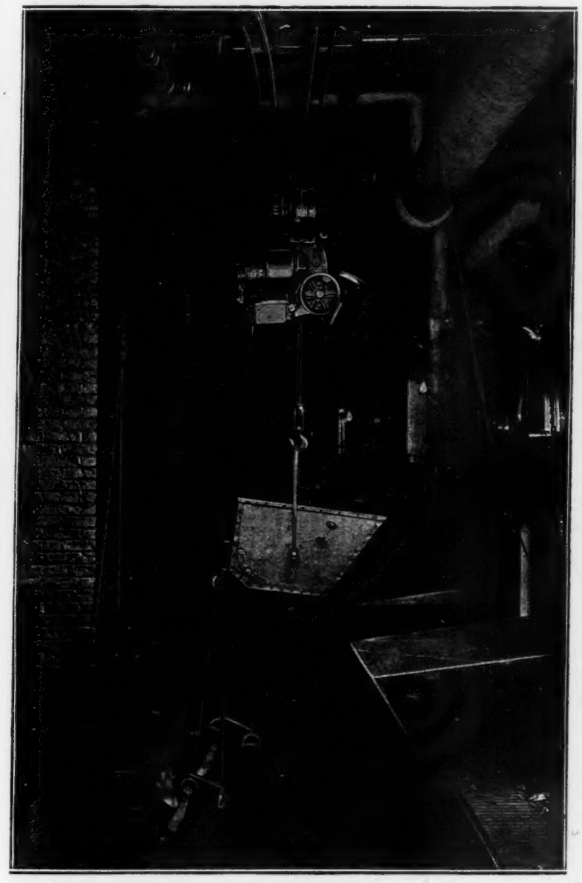


FIG. 1. BUCKET IN POSITION TO BE DUMPED

is an item of labor which means a constant and uninterrupted expense, and scarcely any greater economy can be effected in this direction than the saving of even one man's labor. Such an economy may represent a fair return upon no less an investment than ten thousand dollars, yet the rigid requirements of modern boiler-room practice make such demands upon any automatic coal-handling system that a constant diminution of efficiency is what the engineer has most to dread in an installation of this kind.

An ideal system would enable the coal to be dropped into the bunkers direct from the car or lighter, and fed to the grates without rehandling. This is manifestly impossible in any modern city building, or indeed in any but a few boiler rooms enjoying an exceptionally favorable situation.

And although boiler-room excavations are carried to greater and greater depths in our cities, there are few instances in which the coal can be fed to the boiler room or into the automatic stokers by gravity.

The problems of storage and location are not so easily solved. One of the most interesting solutions of the coal handling problems is found in the new

FIG. 2. TRANSFERRING COAL BY AN OVERHEAD RAIL

Fifth Avenue Building at the corner of 23d Street and Broadway, in New York City.

The boiler room is located 3 stories below the street level and the coal supply is carried in bunkers, which are as favorably located in relation to the boiler room as the general conditions will permit.

There are 21,000 hp. of boilers, equipped with automatic stokers, and the coal handling problem is therefore reduced to the simplest basis. Yet the transfer of the coal from the bunkers to the hoppers of the stokers presents some problems of interest to every engineer.

The coal in this instance is handled in iron buckets holding about 600 lb. These buckets are attached to and hung on the hook of a Yale & Towne electric hoist, which in its turn is built into a trolley running on an overhead track leading from the bunkers to the hoppers of the stokers.

In operation, the buckets are lowered to a point opposite the mouth of the bunker chute to permit the coal to flow into them by gravity from the bunkers. A pull on the switch then starts the electric hoist and the bucket is soon lifted high enough to enable it to start on its journey to the hoppers of the stokers.

This journey, accomplished by means of a smaller motor attached to the trolley which is geared to and drives the trolley wheels, is made in a few seconds, and the coal is then discharged by dumping into the hoppers of the stokers.

A simple switch in the overhead track enables the hoist to be run to a point where it can pick up the ash cans, and these are all handled as swiftly and cheaply as is the coal.

The whole electrical installation is under the instant control of the operation. The hoist will raise or lower the bucket by fractions of an inch, if necessary, and the load is automatically held at all times. The control of the trolley motor is also quite as complete, and the load may be advanced or withdrawn at will.

The hoisting problem is not in itself particularly difficult, but the conditions under which this electric hoist operates are so onerous as to make its continued high efficiency all the more noteworthy. The temperature at the top of the boiler room probably averages 135 deg. and a considerable amount of dust and fine particles of coal are naturally present. Yet this hoist continues to perform its work, day in and day out, showing not the slightest diminution of efficiency.

But an installation of this character is equally adapted to thousands of boiler rooms outside of our cities. Wherever coal has to be transferred, no matter under what conditions, the electric hoist and overhead track show an efficiency in cost of operation against which the old method of wheelbarrows or trucks cannot compete for an instant.

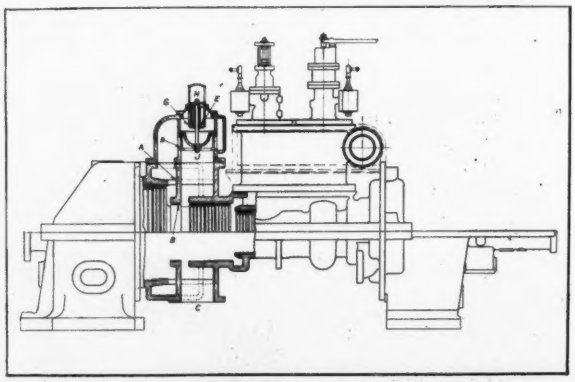
Indeed the combination of either a hand hoist or electric hoist with a trolley running on an overhead track marks a great step in the cheap transportation of materials. The reason is very simple. The device that lifts the load vertically can be pushed or driven by power to its destination direct without shifting the load. The saving in labor and time is great, and the saving in wear and tear is also a considerable factor.

WESTINGHOUSE AUTOMATIC BLEEDER TURBINE

BEING of direct interest to the members of the National District Heating Association, the Westinghouse Machine Company exhibited during the inspection trip of this association to their works on June 7th, 1911, the detail features of one of its new developments in steam turbine design, known as the automatic bleeder turbine.

Its principal advantages result from always using the steam economically before diverting it to the heating system, and at the same time being capable of automatically supplying large quantities of atmospheric or low pressure steam for central distribution or industrial applications without affecting its electrical output.

A diagrammatic sectional detail is shown in the illustration and a description of its operation follows. Generally, the design of the bleeder turbine closely resembles the standard Westinghouse single flow construction. The division wall A, is introduced and strip packing provided at B, forming a labyrinth with no mechanical contact. Thus the steam leaving the intermediate stage may flow into the heating system through the nozzle C or else with a reduced heating demand, a part of the steam passes through the valve D, and performs work in the low pressure section. The automatic valve D is controlled by predetermined pressure in the heating system and the requisite balancing dead weight on the upper side H. The piston E, enclosed in an oil-filled chamber G, is provided to dampen any sudden movement due to pressure fluctuations. Thus if the pressure in the heating system is



ARRANGEMENT OF STEAM TURBINE WITH BLEEDER CONNECTION AND CONSTANT PRESSURE VALVE

fixed at 18 lb. absolute and the pressure at the end of the intermediate section tends to rise due to an increased turbine load, the valve opening will increase, by passing a greater portion of the steam to the low pressure stages. On the other hand, if the load decreases and the pressure at J falls, the valve opening will decrease until the pressure is again built up to 18 lb.

The Westinghouse Machine Company is the patentee and manufacturer of this type of turbine.

IMPROVED WEIGHER FOR LIQUIDS

AT the recent exhibit of the Architecture and Building Material Show held in New York City, the combined exhibit of Henry R. Worthington, the Blake and Knowles Steam Pump Works, the Laidlaw-Dun-Gordon Co., and the Deane Steam Pump Co., was especially interesting. It was an operating exhibit consisting of a Type A open pattern liquid weigher recently developed by Henry R. Worthington for accurately measuring and recording the flow of hot water, chemicals and other liquids which cannot be handled satisfactorily by meters.

In the exhibit and serving as a receiving tank was a Blake-Knowles 150-hp. open feed-water heater, demonstrating by its action the automatic valve control of feed water flow. The weigher discharged into a tank from which the water was lifted to the receiver by a Worthington centrifugal pump, this pump being a 1¼-in. 2-stage with a capacity of 1800 gal. an hour against 70 ft. head and driven direct connected by a 1-hp. motor through flexible coupling.

An important advantage of the weigher is its extreme accuracy in the weighing of liquids of any nature. For example it is independent of the density

of the liquid, and of its temperature, its action being governed entirely by weight and not by volume. A big field is therefore opened to it in the weighing of hot water and it has especial value in power plant application. Its accuracy is practically unaffected by even a considerable variation in the rate of flow, but it is desirable to have the liquid flow into it by gravity. When properly adjusted it is accurate to within ½ of 1 per cent. The weigher has no bearing or wearing surfaces, no valves to leak, and presents no feature which through friction or wear affords an opportunity for any falling off in the original efficiency.

As may be seen from the illustration, the weigher consists of 2 tanks pivoted at a point in their height

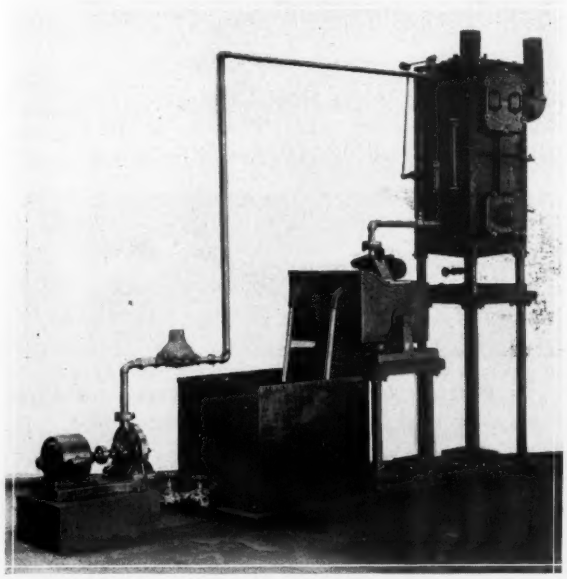


FIG. I. WATER WEIGHER MADE BY HENRY R. WORTHINGTON WITH OPERATING APPARATUS MADE BY INTERNATIONAL STEAM PUMP CO. BRANCHES

which is above the center of gravity when the tank is empty. As the tanks alternately fill the center of gravity is raised until it comes above and to one side of the center of support which causes the tank to tip on its knife edge bearings and start the discharge of the liquid through the bent pipe outlet. This pipe is continued within the tank as the short leg of a siphon so that the flow, being once established, continues until the tank is drained even, after the center of gravity has been lowered and the tank tilts back to the normal position.

As each tank tips, it automatically turns the rocking inlet spout so as to deflect the water into the other tank and that one is filled while the first is discharging. Each movement of this spout actuates a mechanical counter which is calibrated to read either the number of loads of the tanks, or directly in pounds, gallons, or whatever unit of measure may be desired. From the nature of the action of the weigher and the sensitiveness of the balance of the tanks, the tank loads are all of uniform amount. Since the record is by weight, the counter reading is final, without necessity of making any allowances or corrections.

AS A NONCONDUCTOR of heat, soot is one of the most effective materials known.

IMPROVED FLOW METERS

IN order to use water, steam, gas or electricity economically, it is necessary to know not only the amount available by generation or otherwise, but more particularly the amount actually delivered or distributed.

While very satisfactory forms of Watthour meters have been developed for measuring electricity, until recently the devices for measuring steam, gas, water, etc., have not been nearly as accurate. Therefore, in order to meet the growing demand for such meters, the General Electric Co. has developed several types of flow meters of approved design and high efficiency.

These include both the recording and indicating types, the former making a continuous graphic record of the rate of flow and the latter giving readings of the instantaneous values. The unit of measurement varies with the commodity measured, being pounds per hour for steam, cubic feet per minute for air and gas, and gallons per minute for water.

The recording water flow meter comprises a nozzle plug for screwing into the pipe at the point where the

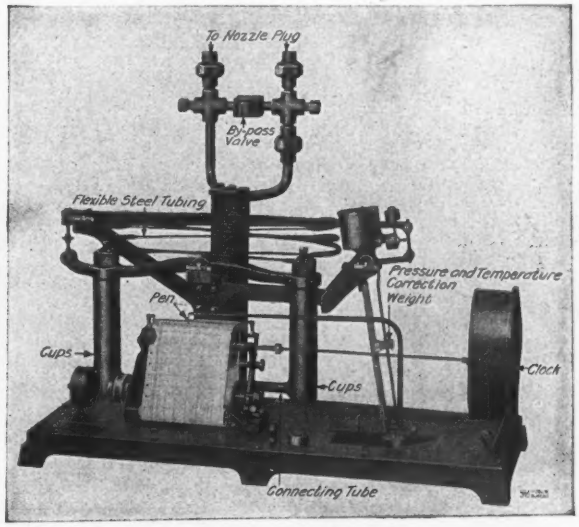


FIG. I. RECORDING WATER FLOW METER WITH AUTOMATIC PRESSURE COMPENSATION

flow is to be measured, thus being exposed to the pressure of the water, a meter element which measures the pressure set up in the nozzle plug and a recording mechanism which makes a graphic record of the rate of flow.

The nozzle plug has 2 sets of orifices, the "leading set" located parallel to its axis extending across the main and facing the direction of flow, and the "trailing set," consisting of 3 holes located on the opposite side of the plug near the middle and at right angles to its axis. The 2 sets of orifices open into separate longitudinal chambers leading to the outer end of the plug. The nozzle plug is suitably arranged for use on either vertical or horizontal mains, and its introduction causes no appreciable drop in static pressure even at very high rates of flow.

When the plug is inserted in the main, the water impinging against the orifices of the leading set develops therein a pressure equal to the static pressure plus a pressure due to the velocity head; while the pressure set up in those of the trailing set is equal to

the static pressure minus a pressure due to the velocity head, thus causing different pressures in the longitudinal chambers leading to the outer end of the plug. The different pressures are communicated to the meter through suitable pipes attached to the outer end of the plug and connected to flexible steel tubing placed within the meter case.

The meter element consists of 2 vertical cups or hollow cylinders connected together at the bottom by a tube. The U tube thus formed is filled with mercury to about half the height of the vertical cups and the whole arrangement is supported and is free to move about a set of knife edges like an accurately constructed balance.

The different pressures in the 2 sets of orifices in the nozzle plug causes the mercury to rise in the left

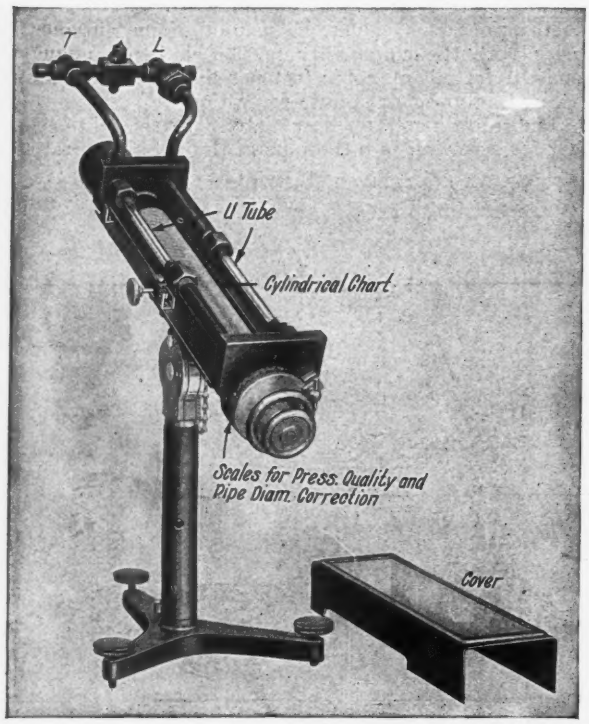


FIG. 2. INDICATING STEAM FLOW METER SHOWING SCALES

hand cup and to fall a corresponding amount in the right hand cup until the unbalanced mercurial column exactly balances the difference in pressure. This action causes the beam carrying the cups to descend on the left hand side of the knife edges until the moment of the weights on the right hand side exactly balances the moment caused by the displacement of the mercury into the left hand cup. The motion of the beam is multiplied by means of levers and actuates the recording pen, the movement of the latter being proportional to the amount of mercury displaced.

The drum carrying the recording paper is driven by an 8-day clock. The paper is calibrated to record the flow in gallons per minute and the rate of flow may be read at any instant, or the average rate calculated for any given length of time.

The standard paper furnished is calibrated for a rate of feed of 3 in. per hour, but paper for feeding at 1 in. or 6 in. per hour can be supplied if desired. The meter is equipped with a spring operated re-roll device capable of holding one complete roll of paper.

Although the meter is calibrated to record the rate of flow in gallons per minute at 39.1 deg. F., suitable means are provided for readily setting it for different temperatures, pipe diameters and rates of flow. In order to measure the flow under normal conditions in any number of different pipes, it is only necessary to use nozzle plugs of sufficient length to extend across the pipes, and record paper of suitable calibration range.

This meter is useful for ascertaining the output of pumping plants; the total amount of water consumed by a municipality or the amount distributed to different sections thereof; the input to water turbines and their loss of efficiency; the amount of water consumed in manufacturing processes; the amount of feed water delivered to boilers; the amount of cooling water used in condensers; the slippage in pumps due to leaky plunger packing or worn out valves, and for discovering losses due to leaks in water mains, etc.

The recording air flow meter, suitable also for measuring steam and gas, operates on the same principle as the recording water flow meter and is practically similar in all details of construction.

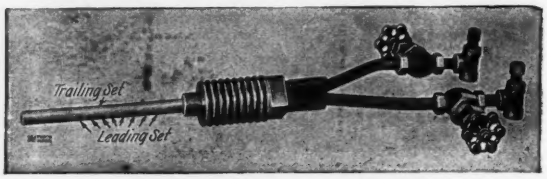


FIG. 3. NOZZLE PLUG AND PIPING FOR WATER FLOW METER

The indicating steam flow meter is designed for testing work and other purposes such as locating trouble due to leaks, determining efficiency of boilers, etc., where accurate, instantaneous readings of the rate of flow are desirable.

This type of meter operates on the same principle and employs the same type of nozzle plug as the recording meter, but differs considerably in details of construction. It can be readily adjusted for various rates of flow and indicates the instantaneous rate of flow in pounds per square inch of pipe cross sectional area for steam, or in cubic feet of free air at 70 deg. F., for air.

66-INCH EXHAUST STEAM SEPARATOR AND OIL ELIMINATOR

THE accompanying cut illustrates the latest design of exhaust steam separator and oil eliminator of the right angle steel shell type now being manufactured by The Hoppes Mfg. Co., Springfield, Ohio, for use in connection with low-pressure turbines.

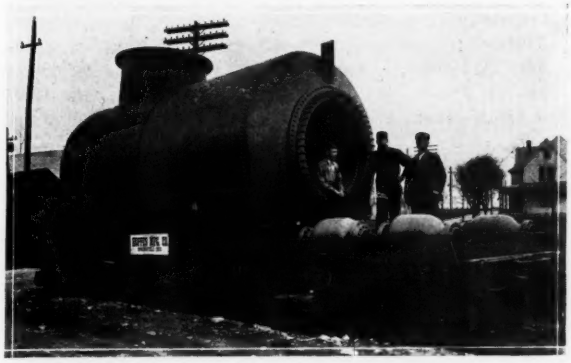
This particular machine is one of the largest, if not the largest, of its class ever manufactured, and was built for The Milwaukee Electric Ry. & Light Co., Milwaukee, Wis.

The shell of the apparatus is 10 ft. in diameter by 23 ft. long, and it is designed to eliminate the oil and water from 385,000 lb. of exhaust steam per hour before the steam is used in the operation of 2 7500-kw. low-pressure turbine units.

Exhaust steam from the reciprocating engines enters the separator through the flanged opening on the side of shell near the top and the purified steam passes out at the bottom.

All the Hoppes principles of construction for this

type of separator are found in this machine; it is built with large internal areas to allow a free and unrestricted flow of steam, and equipped throughout with intercepting troughs partly filled with water to catch and remove all entrainment.



LARGE HOPPES STEAM SEPARATOR AND OIL ELIMINATOR

The exhaust inlet flange of this separator is 5 ft. 6 in. diameter which gives some idea of its enormous capacity and size.

THE LYTTON STEAM TRAP

DRAINING the condensation from a steam plant is as important as any feature of the installation and for such work the steam trap is a most valuable apparatus. The Lytton trap is a design resulting from years of practical experience in the handling of condensation by the designer, Mr. Lytton, and is arranged with all working parts, except bucket float, on the outside of the receptacle, in sight and readily accessible, yet no stuffing boxes are used making it desirable on vacuum systems. Also, as these parts are accessible, any automatic function of the trap can be performed by hand in case of necessity.

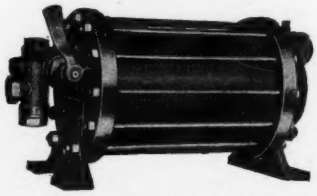


FIG. I. LYTTON STEAM TRAP ASSEMBLED

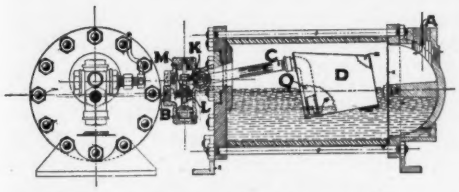


FIG. 3. CROSS SECTION OF WORKING PARTS OF LYTTON TRAP

Figure 1 shows the trap complete, Fig. 2 partly disassembled for inspection, and Fig. 3 the cross section of the trap. When the trap is first installed it is necessary to fill the receptacle approximately half full of water, either by pouring in water or by holding the discharge valve closed until the receptacle is half filled. This leaves the float standing in position shown in Fig. 3. With this condition established, water flowing into the trap through the inlet opening A will raise float D until it strikes the outer casing. When the trap has filled, water will flow into the float, causing it to drop to the bottom and raising by this action the

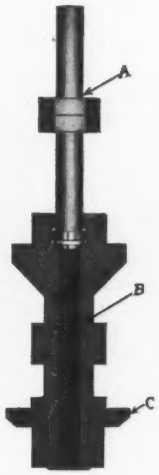


FIG. 4. DETAIL OF VALVE

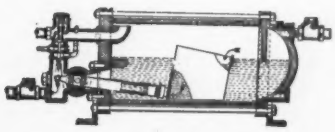


FIG. 5. RETURN FORM OF LYTTON TRAP

lever K, which raises auxiliary valve M and admits the pressure from the inside of the trap to the underside of the piston attached to main valve L. This opens the main valve and water flows out of the trap through the float D, connecting pipe Q, and pipe C to outlet B. Water will flow from the trap until it is level with the top of the float, the float being at its lowest position. The pressure will then blow the water out of the float until it will be so lightened that it will rise to the position shown in Fig. 3, closing the discharge valve, which will remain closed until the bucket again fills and drops to the bottom.

The construction of the valves is shown in Fig. 4, in which the letters do not correspond with those in Fig. 3. The nickel auxiliary valve A, of Fig. 4, is the valve M of Fig. 3, and this being raised permits pressure to pass through the opening B, Fig. 4, to the under side of the piston C, Fig. 4, which corresponds to L in Fig. 3. As this piston has a larger area than the main valve, the pressure lifts it from its seat, giving a large valve opening and consequent large discharge capacity. The valve seat is of nickel, as this metal wears best of any for the purpose. In Figs. 2 and 3 it will be noted that the inlet head has a copper gasket which also serves as a vertical strainer, a plug being provided at the bottom of this head for cleaning out sediment or other matter which is stopped in this strainer chamber. The float is open, therefore cannot

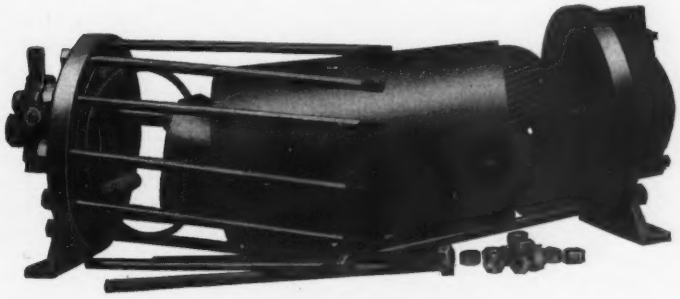


FIG. 2. TAKING THE TRAP APART

become waterlogged and cause the trap to refuse to work.

The Lytton trap in its return form can handle condensation from any source and by the use of boiler pressure deliver it back to the boiler if desired. Of course, where the condensation returns to a point below the water level in the boiler, 2 traps must be used, one to raise the condensation above the boiler level, the other to return the water to the boiler. For the trap which returns water to the boiler the outlet should be not less than 4 ft. above the water line in the boiler, 6 to 8 ft. being preferable, and the live steam connection for equalizing pressure must communicate directly with the boiler. Discharge from the trap should be directly into the boiler below the water line at the most quiescent point. It may be connected to the bottom blowoff by a T connection between the blowoff and the boiler.

The return form of trap differs somewhat from the one already described as indicated in the sectional view Fig. 5. The body of the receptacle is filled half full of water, as in the previous case, thus elevating the bucket float to a position high enough to close the steam valve and open the vent valve. The cut shows the trap discharging into the boiler, the water having passed out as indicated by arrows until the minimum level is reached. As no more water can flow from the trap to the float, the water in the float flows out, permitting the float to rise until the levers operate to pull the vent valve from its seat, thus allowing the steam valve to close. The boiler pressure which is then in the trap is relieved by flowing out through the vent valve and as soon as the pressure in the trap has reached the point where the pressure in the steam will lift water to the trap, the water will flow in gradually, lifting the float until it strikes the casing. The float then fills and falls to the bottom position, as in the case of the non-return trap.

This trap is made by the Lytton Mfg. Corporation of Franklin, Va., and is handled by General Sales Agent D. J. Lewis, Jr., 50 Church St., New York.

NEWS NOTES

THE FIRST ANNUAL CONVENTION of the Institute of Operating Engineers will be held in New York City, Friday, Saturday and Sunday, September 1st, 2nd, and 3rd, 1911. Sessions of the convention will be held in the Engineering Societies Building, 29 West 39th Street, New York City.

As this is the first meeting of the Institute, much business of importance will be transacted in the way of adopting the Constitution, By-Laws, Educational Requirements, Apprenticeship Requirements, regular Study Courses, Lists of Books, etc.

The first day's session will consist of addresses by prominent speakers, the appointment of Committees and allotting of work to the same. The second day's session will be taken up with the executive business of the Institute. The third's day's session will be given over to sight seeing.

Special rates will be provided for all those who attend the convention. Ladies who attend with members of the Institute will be entertained by a special committee who will show them the sights of the city.

All those who expect to attend this convention are requested to write at once to the secretary and notify him. Information as to the hotel rates can be secured by addressing the secretary, Hubert E. Collins, 29 West 39th Street, New York City.

FRITZ A. LINDBERG has been admitted to partnership in the firm of Brill & Gardner, consulting engineers on the design and construction of power plants and factories, and will continue with them in the office at 1138 Marquette Bldg., Chicago. Mr. Lindberg was graduated from Armour Institute of Technology 10 years ago, and has since been associated with the firm of Brill and Gardner in responsible charge of design.

OWING TO THE RAPID growth and increase of business of The Paul B. Huyette Co., Inc., manufacturers of the "P. B. H." water gage, "P. B. H." gage cock and other high grade steam specialties, it will remove on or about August 31 from its present 5-room quarters in the Betz Building, Philadelphia, to the southeast corner of 18th and Market Streets, Philadelphia, where it will occupy the entire third and fourth floors, which are about four times as large as its present quarters.

CHAS. B. SCOTT & Co., 119 Franklin Ave., Scranton, Pa., have been appointed agent of the Homestead Valve Mfg. Co. for Scranton and vicinity, and will carry a stock of Homestead valves ready to supply the trade.

HENRY J. MARKS will in future be sole agent in the New York district for the American Engine Co., of Bound Brook, N. J. Mr. Marks has had long experience in operation of American Ball engines, both simple and compound types, and will, of course, be able to place this experience as well as data and information he has accumulated in regard to power plants for central stations at the service of his customers. His address will be 90 West St., New York.

N. B. AYERS has resigned his position as chief engineer of the Dayton Power & Light Co., and has organized the Ayers Engineering Co., to handle power plant engineering. Mr. Ayers is a member of the American Society of Mechanical Engineers and will make a specialty of inspection, installation, and operation of plants. His address will be Conover Building, Dayton, Ohio.

FREDERICK K. BLANCHARD, 422 River St., Troy, N. Y., will in future represent the Homestead Valve Manufacturing Co., in the cities of Albany and Troy, N. Y., and vicinity. Mr. Blanchard will have quite a stock of Homestead Valves on hand at all times and will be prepared to supply the engineers and power plants of those cities on short notice.

ASHLEY P. PECK, who has until recently been associated with the Allis-Chalmers Co., New York, as sales engineer, resigned that position to become district sales manager for A. L. Ide & Sons, with offices at 814 People's Gas Building, Chicago. Prior to Mr. Peck's residence in New York, he had charge of the Milwaukee sales office of the National Electric Manufacturing Company, covering the Middle West from that office. Before going to Milwaukee he was associated with the World's Columbian Exposition, and with the Chicago offices of the Westinghouse Electric & Manufacturing Company and the General Electric Company. He has an extensive acquaintance in the machinery field of the Middle West, and has returned to his native territory actively to advance the interests of Ideal engines.

IN CONNECTION with its representation of the Russell Engine Co., the Griscom-Spencer Co., with offices at 90 West St., New York, which handles the Russel engine in New England, New York, Northern New Jersey, District of Columbia, Virginia, Tennessee and Arkansas, will be represented in this work by Homer M. Clark, 226 Fidelity Building, Buffalo, N. Y., C. E. Scrimgeour, 11 Pine St., Lewiston, Me., A. S. Vantres, Box 391, Bangor, Me., Schumacher & Santry, 141 Milk St., Boston, R. H. Larkin, 9 Orchard St., New London, Conn., D. MacArthur, West Haven, Conn., J. B. Como, Barre, Vt., and J. F. Vunkannon, Memphis, Tenn.

FRANK W. HALL, manager of the Philadelphia office of the Sprague Electric Works, has been appointed manager of hoist sales and after July 15, 1911, will be located at the New York office.

JAMES A. CLIFFORD, manager of the Baltimore office of the Sprague Electric Works, has been appointed manager of the Philadelphia office and took charge there on July 1, 1911. The Baltimore office will be continued as in the past under Mr. Clifford's direction, but as subsidiary to the Philadelphia office and with Henry S. Patterson in charge.

CATALOG NOTES

LOWER FIRST COST of belted generators compared with that of direct connected units is sufficient to create a large demand for such machines where space is not a serious consideration. To meet this demand the General Electric Co. has designed a standard line of belt-driven alternating-current generators, known as Form B, which are described in Bulletin 4847, recently issued. These generators are built in capacities ranging from 50 to 200 kw. and are adapted for 3-phase or 2-phase winding without change except in the armature coils and terminal blocks, the exciters and all accessories being the same for both. Designs have been made for 240, 480, 600, 1150 and 2300 volts.

FROM THE INGERSOLL-RAND CO., 11 Broadway, New York City, comes a folder describing a Remarkable Record of Core Drill Success. It explains in detail the advantages of the core drill system in showing the character of ground passed through, in increased speed of drilling, and in reduced cost. Copies of this folder or of other literature describing air compressors, rock drills, hammer drills, flat drills, electric air drills, coal punchers, coal shearing machines, stone channelers, air hoists, pneumatic tools, and air lift pumps, can be had by writing to the company at this address as given above.

THE RUST BOILER is described in a handsome book sent out by the Babcock & Wilcox Co., giving the history of the development of the boiler, the details of construction, showing the advantages in simplicity, efficiency, great overload capacity, and adaptability to special conditions. Illustrations of a large number of plants where Rust boilers are in successful operation are also given. The boiler was developed especially to meet the hard conditions of steel mill practice and has proved so successful that it has been installed in a great number of plants. The book is an interesting one to read and the illustrations are attractive and convincing.

WARREN WEBSTER & CO., Camden, N. J., have just published an extremely attractive pamphlet entitled "Webster Vacuum Heating System in the Boston City Hospital." It describes the installation in the face of unusual obstacles of the "Hy-Lo" or Type "D" system in 26 buildings of this hospital. The pamphlet will be sent gladly to interested parties if they will write the company at Camden, N. J.

CATALOG NO. 10 OF THE Wm. Powell Co., Cincinnati, O., is an attractive book of 300 pages illustrating and describing fully the complete line of specialties manufactured by this company. It shows the different styles of valves manufactured, the dimensions and amount of space occupied and the index enables quick reference to any part of the book. Tables of useful information on chimneys, steam pipe practice, properties of metals, belting, alloys and mathematical values are included in the book. Copy can be had by writing to the Wm. Powell Co. and stating the position which one holds.

OSTER THREADING TOOLS as made by the Oster Mfg. Co., of Cleveland, O., are described in Catalog 26 just issued. This includes the Bull Dog gear stocks, die stocks, pipe and nipple machines, screw plate for bolts and other machinery useful in handling large and small pipe.

STEAM-HYDRAULIC FORGING AND BENDING PRESSES, as made by the Mesta Machine Co., of Pittsburg, Pa., are fully described and illustrated in the company's catalog recently received and which can be had by writing to them at their Pittsburg address, Oliver Building.

FROM THE ROTO CO., of Hartford, Conn., comes a catalog describing the Roto tube cleaners for steam boilers, condensers, heaters, etc., driven by air, steam and water and made for operation in either straight or bent tubes. The catalog is instructive as to the construction and operation of these cleaners and shows the different types of heads for handling various kinds and thicknesses of scale.

NO. 30 IS THE CATALOG and price-list issued by the Chapman Valve Mfg. Co., of Indian Orchard, Mass., a substantial cloth bound book of 170 pages, containing descriptions, outline drawings, dimension tables and prices on valves, combination valves and fittings, hydrants, flanges, valve operating mechanisms, and sluice gates. It is a fine volume, interestingly gotten up and beautifully printed.

OHIO VALVES AND STEAM SPECIALTIES as made by the Ohio Brass Co., of Mansfield, Ohio, are shown in a beautiful book called Catalog K, which has just been received. This shows the Ohio valves for hot water and steam radiators, globe valves, check valves and the Ohio gate valve, Ohio standard gage cock, Ohio water gage, Ohio pressure regulating valves of different types for steam and vacuum service. All apparatus is carefully illustrated, both in full view and in cross section, and a complete description is given. The catalog is printed on a heavy enameled stock and with a most attractive cover. It will be found interesting reading by all who receive it and can be had by writing to the Ohio Brass Co.

ECONOMICAL STEAM PRODUCTION is the title of a catalog issued by the Vulcan Soot Cleaner Co., of Pittsburg, Pa., describing the method of action of the Vulcan soot cleaner and how it increases the efficiency of the boiler plant.

AMERICAN SPIRAL PIPE WORKS, of Chicago, which manufactures spiral riveted pipe, flat welded steel pipe, flanges and exhaust steam piping, shows in its new catalog examples of installations made with its product for different purposes, and also the results of tests on the forged steel flanges.

INTERNATIONAL STEAM PUMP CO. is issuing 2 attractive bulletins, the first of these, W 185, describing centrifugal house and sump pumps made by Henry R. Worthington, the second describing Type D centrifugal pumps for low head service made by the same concern. Each bulletin gives complete illustration and detail of the machinery described, together with table of dimensions, speeds, capacities and power required.

BULLETINS OF THE BRISTOL CO., of Waterbury, Conn., are always interesting as new material and new methods of taking record charts are found in them. In the Bulletin 131 on Recording Voltmeters for Direct and Alternating Current are found new styles of portable form instruments as well as of fixed gage board instruments, and the different styles of

charts and graduations are fully illustrated. Full size charts are shown as well as reduced drawings. The construction of the voltmeters is clearly illustrated and described and the dimensions showing the space taken up on any board are given. Bulletin 147 A shows the Bristol-Durand averaging instrument for getting the average radius on circular charts and describes the method of using it. Bulletin 142 describes the recording water level gages designed for securing records of water level where the instrument must be at a higher level than the surface of the water or other liquid whose depth is to be recorded. The bulletin shows the actual installation of such a gage on the bank of a small river and in connection for use with irrigation systems where such records are of assistance in determining the amount of water furnished.

GENERAL ELECTRIC CO. has just issued Bulletin 4845 containing illustrations and descriptive matter in considerable detail of its Curtis horizontal steam turbine generators of from 100 to 1000 killowatts capacity at 3600 r. p. m., which is the maximum speed possible for use with 60-cycle alternating-current generators. These units are particularly adapted to industrial and lighting plants requiring the economical generation of a moderate amount of power.

BULLETIN NO. 4834 of the General Electric Co. comprises an article on the Electrical equipment of the Detroit River Tunnel, reprinted from the Electric Railway Journal. It contains illustrations of exterior and interior of converter and transformer substations, shows various methods of construction and insulation, as well as the size of locomotives and location of apparatus; also the construction and size of the tunnels, and substation wiring.

GENERAL ELECTRIC CO. has just issued a publication describing another of its flow meters, which, in this instance, is designed for measuring the flow of steam. Two forms of the steam flow meters are manufactured; one for recording and the other for merely indicating the flow. This meter resembles somewhat the air and water meters manufactured by this company, and is fully illustrated and described in this publication, which is 4836.

SPECIAL BOILER FEED-WATER HEATER for heating 2 water supplies separately and apart is described in a pamphlet which we have just received from the Harrison Safety Boiler Works, 3144 North 17th St., Philadelphia, Pa. The heater is, in general, of the Cochrane open type, receiving the exhaust steam through an attached oil separator. The water supplies, however, are received in 2 separate distributing boxes, which deliver to separate heating trays, from which the water drops into separate storage chambers, the idea being that in many plants there are 2 different water supplies which are used for different purposes, as for instance, where the condensed returns or condensate from surface condensers is to be used for washing or dyeing, while city or well water is used in the boilers. As compared with heating the different water supplies separately in 2 different heaters, this arrangement represents a considerable saving on cost of heaters, and of valves, piping, etc., while occupying much less room, and being more compact and convenient. The pamphlet contains several drawings showing piping arrangements for the storage of water for dye-tubs, scouring vats, etc. Copies will be sent upon request to those interested.

PLANING MILL EXHAUSTERS is the title of a 20-page, 6 by 9 in. pamphlet, issued by the Green Fuel Economizer Co., of Matteawan, New York, and describing low-speed and standard-speed types of planing mill exhausters. The low-speed machine is a recent improvement designed to effect economy of power. It provides a large and slow running fan, which will consume little power when passing the needed amount of air, and which when installed with piping of the proper dimensions, will insure the required volume and suction for picking up materials at the intakes.

A CLEVER LITTLE FOLDER with some pertinent pointers and facts on "Economical Steam Production" has just been issued by the "Diamond Power Specialty Company, Detroit, Michigan. Any boiler room operator would do well to drop a card to this company for a copy of this interesting treatise.

GOULDS MFG. CO., of Seneca Falls, N. Y., is preparing a bulletin illustrating the complete line of side suction centrifugal pumps. An advance bulletin describing the single stage pumps contains illustrations of the different styles and methods of driving, and description in detail of the parts of the pumps.

BULLETINS G AND H from the Precision Instrument Co., Detroit, Mich., illustrate and describe a new simple, cheap and accurate calorimeter for determining the heating value of solid fuels and Carpenter's Metropolitan Argand Burner for use with any kind of coal gas.

BULLETINS 121 AND 122 issued by the American District Steam Co. refer respectively to the development and application of central station heating and district steam heating plants. The first is by Chas. R. Bishop and is a paper read before the Pennsylvania Electric Association. The second is by Paul Mueller, reprinted from the proceedings of the American Society of Municipal Improvements.

A PIPE THREADING MIRACLE is the title of an interesting little book issued by the Toledo Pipe Threading Machine Co., of Toledo, Ohio, and which tells the story of the tools that have changed all previous notions of the work required to thread pipe by hand. The use of the threading machinery is shown by different illustrations, some particularly tight places being noted.

THE CLIMAX SMOKE PREVENTER, made by the Climax Smoke Preventer Co., Boston, is described in a catalog which shows the details of construction and operation and some of the results gotten from testing boilers used with and without the smoke preventer.

CENTRAL HEATING, a most interesting book published by the American District Steam Co., of Lockport, N. Y., tells of the design, installation and operation of public service plants which combine the furnishings of electric light and power with the furnishing of heat for buildings. The illustrations in the book show stations which furnish central heating and buildings which are equipped to use this service, also the methods of laying conducting mains and for taking care of expansion and contraction. Advantages of this system are shown and the method of charging for heating service is discussed.

FROM A. L. IDE & SONS, Sprinfield, Ill., come 2 interesting bulletins, No. 17 dealing with the Ideal engines of simple, side tank types, direct connected generator, showing the details of construction of bearings, crank shaft, eccentrics, governor, etc., and describing just how the engine operates, giving its advantages. No. 18 is the bulletin on side tank tandem compound engines and gives the same information as regards details as the other bulletin, with the exception that the cylinder arrangement is different and is shown by means of special illustration and description.

FROM ALLIS-CHALMERS CO. come 2 bulletins, No. 1081, which supersedes 1040 and describes the

Allis-Chalmers polyphase induction motors of squirrel cage and round armature types, and Bulletin 1523, superseding Bulletin 1513, stationary air compressors for industrial uses.

COOK'S METALLIC PACKING, made by C. Lee Cook Mfg. Co., Louisville, Ky., is shown in a new catalog and the different methods of applying this for steam, gas and air machinery are fully shown and described.

THE LATEST IMPROVED ROCHESTER Automatic Lubricators made by Greene, Tweed & Co., New York City, are of all types and capacities suited for every kind of machinery. They are made in from 1 to 6 feeds, all with round bodies. The catalog illustrates and describes, besides the lubricators, the Multiplus Sight Feed, the Improved Check and Vacuum Valve, and shows views of the methods which may be employed in the attachment of the Rochester lubricator to the machine which it lubricates.

GENERAL CATALOG NO. 40 of the Chain Belt Co., in Milwaukee, is a 260-page book giving complete details in regard to the conveying, elevating and carting machinery manufactured and installed by that company.

MINERS' CIRCULAR NO. 1, the first of a series to be written in plain, non-technical language for the benefit of the miner has just been issued by the Federal Bureau of Mines. It contains the names of the permissable explosives tested by the bureau at its Pittsburg station up to November 15, 1910 and gives precautions as to their use. Permissable explosives give a short and relatively cool flame that is less likely to ignite inflammable gas or coal dust than is the longer and hotter flame of dynamite or the longer and much more lasting flame of black powder. Because they can be used with greater safety, permissable explosives have taken the place of other explosives in many coal mines in the United States during the last 2 yr. and their use is increasing rapidly.

DOHERTY GAS CALORIMETER, manufactured by the Improved Equipment Co., of New York City, is an apparatus for the determination of the heat value of different gases. The details of construction and the method of operating it are shown in a folder recently received.

AN INTERESTING PAMPHLET from the Strong Machinery & Supply Co., of New York, describes Dichtungsgummi packings, Adamant gage glasses and other specialties marketed by this concern.

THE WILMINGTON INSTITUTE Free Library of Wilmington, Del., is endeavoring to secure and arrange a collection of trade catalogs of various manufacturing concerns for the use of readers at the library. Any trade catalogs will be gladly welcomed by the library and will be properly filed and indexed.

SPONTANEOUS COMBUSTION OF COAL with special reference to bituminous coals of the Illinois type, by S. W. Parr and F. W. Kressmann, has just been issued as Bulletin No. 46 of the Engineering Experiment Station of the University of Illinois. The bulletin describes a series of experiments directed toward the determination of the fundamental causes underlying the spontaneous combustion of coal. These causes may be summarized as follows. (1) external sources of heat, such as contact with steam pipes, hot walls, and the impact of large masses in the process of unloading, height of the piles, etc.; (2) fineness of division; (3) moisture; (4) activity of oxidizable compounds, such as iron pyrites. An historical review of the literature upon the spontaneous combustion of coal is given in the appendix.

Copies may be obtained gratis upon application to W. F. M. Goss, director of the Engineering Experiment Station, University ot Illinois, Urbana, Illinois.

THE CIRCULAR OF INFORMATION of Franklin Union, 1911-12, shows the presentation of courses in steam engines, boilers and firing, heating and ventilation, gasoline engines and industrial electricity. Work is done in evening courses and on Saturday afternoons, the evening sessions being held on Monday, Tuesday, Wednesday and Thursday. Full information in regard to the ground covered and cost of courses can be had by writing to Walter B. Russell, Director, Franklin Union. Berkeley & Appleton Sts., Boston, Mass.

TRADE NOTES

A NEW SPECIALTY marketed by the H. W. Johns-Manville Co., is Solderall, a solder put up in collapsible tubes, to be squeezed out on the parts to be mended, then heated with a match or soldering iron and results in a soldered joint. For anyone who has occasion to make repairs of this nature it is a worthwhile convenience.

THE AMERICAN SHIP WINDLASS CO. report 2 orders just received for Taylor stokers. The first is for 12 stokers for the New York Edison Co., making a total installation in the Waterside Station of Taylor stokers for 52,650 hp. of boilers. The second is for 5 Taylor stokers for the U. S. Naval Gun Factory at Washington, D. C. These stokers are to be used under 300-hp. B. & W. boilers.

THAT BELTS ARE MADE water proof is evidenced by the following letter to Chas. A. Schieren Co. "This is to certify that the Duxbak belt furnished by the Chas. A. Schieren Company, of Vienna, in December, 1909, for the cable-railway power station of this place, was under water during the floods in the Ill valley for 24 days without being damaged at all. This endless belt was put into service again August 8, 1910, without being repaired in any way, and is working as fine as it ever did.—Department of Forests of the Imperial Town of Feldkirch."

THE CAPITOL, metal valve disk, made by the Hartford Mill Supply Co., is a compound of several metals which have shown on long practical test that the disk has sufficient strength to prevent cutting or breaking, yet is soft enough to make perfect seat under all conditions. It is made by the Hartford Mill Supply Co., of Hartford, Conn.

MAX MACHINE CO., of Clinton, Mass., is introducing a new device called the Minute Emergency Expansion Plug. This is for remedying leaking boiler tubes when the plant cannot be shut down to make permanent repairs. The plugs are of steel shaped to fit exactly into the ends of the tubes and in a lot of a dozen there are 4 plugs of 3 different sizes, varying ten one-thousandths of an inch in diameter. The right size of plug being selected, it is driven into the marked end by tapping it around the edge until it is flush with the tube end. The plug will hold the boiler from leaking until such time as a new boiler tube can be inserted, when the plugs are simply split by means of a chisel, the same as the tube end, and will come out without difficulty.

THE GRISCOM-SPENCER CO., 90 West St. Bldg., New York City, who are representatives for The Russell Engine Co., of Massillon, Ohio, for the New England States, are meeting with excellent success among purchasers of high grade engines. They will be pleased to mail catalogs to any interested engineer or prospective buyer and quote prices on complete steam plants.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 40 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office on or before the 20th of month preceding publication.

Positions Wanted

POSITION WANTED—By married man, sober and reliable, with 12 years' experience. Understand A. C. and D. C. electricity and ice machinery. Can give good references. Address Geo. Abel, Ness City, Kansas. 8-2

POSITION WANTED—In engine room or electrical power plant, by electrician with 7 years' engine room and electrical experience. Will go anywhere, but prefer the west or middle west. Address Box 182, Practical Engineer, Chicago, Ill. 8-1

POSITION WANTED—Engineer would like to take charge of small plant or act as assistant in large one. Have had 7 years' experience. Familiar with the operation of both A. C. and D. C. generators. W. Break, 136 Jones St., Detroit, Mich. 8-3

POSITION WANTED—By engineer. At present employed by the City of Newark. Best of references given from this source. Will go any place where there is opportunity and a steady position. Address Box 180, Practical Engineer, Chicago, Ill. 8-1

POSITION WANTED—Young man who wishes a position as oiler or assistant in engine room, would like to give some chief engineer his qualifications and references. Experienced. Now employed. Good reasons for changing. Address Box 181, Practical Engineer, Chicago, Ill. 8-1

POSITION WANTED—As engineer by a middle-aged man. Have a first-class license and can do own repairing and pipe fitting. Married; strictly sober. Address Jasper M. Mallette, 4020 25th Ave. So., Minneapolis, Minn. 7-2

POSITION WANTED—By electrician, 27 years of age, to take charge of electric light and power station. Seven years' practical experience. Married. Strictly sober. Address Box 174, Practical Engineer, Chicago, Ill. 7-2

POSITION WANTED—With engine builder as erecting engineer. Have some erecting experience and 12 years' power plant experience. Age 34; married; strictly sober and industrious. Good references. Address Box 176, Practical Engineer, Chicago, Ill. 7-2

POSITION WANTED—In power plant, by young man 22 years of age. Am taking A. S. C. course in electrical engineering, and have a little steam, gas and electrical practical experience. Any reasonable offer considered. Address Box 179, Practical Engineer, Chicago, Ill. 7-2

POSITION WANTED—As chief engineer in electric power plant or as second in large plant where turbines, gas engines or refrigerating machinery is used. Familiar with all types of reciprocating engines, boilers, air compressors, hydraulic machines, etc. Good references. Will go anywhere upon reasonable notice to present employer. Middle-aged; married. Address Box 177, Practical Engineer, Chicago, Ill. 7-2

Help Wanted

AGENTS WANTED—TO SELL LURRICATING oils, belts, hose, paint, varnish for power machinery, to factories, mills, auto owners, stores, threshers. Exclusive territory to right party. Oil experience unnecessary. Manufacturers Oil and Grease Co., Cleveland, Ohio. 8-tf.

COMPETENT AND EXPERIENCED stoker erectors at once. State age, experience, reference and salary expected. Give full details. Address Box 168, Practical Engineer, Chicago, Ill. tf.

BE AN AGENT FOR Practical Engineer in your city. Pleasant part or whole time work calling on your engineer friends. Liberal cash commission on every subscription taken. Write to Subscription Dept. for information. 7-4

ENGINEERS AND MECHANICS—To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4-tf.

Wanted

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write the Subscription Dept. They will start you in at once. 7-4

WANTED—5,000 STATIONARY ENGINEERS to send us their name and address. A good proposition open to each one. For full particulars, write Henry W. Lord, 7 S. Greene St., Baltimore, Md. tf.

For Sale

FOR SALE—One H. S. IDEAL ENGINE, 17x16, 250 Rev. center crank, 2 flywheels 78x20 and 18x14. Endless belt to go with same 68 feet by 18 inches for the sum of $600.00 cash. Address Fred Hohmann, City Clerk, Blue Island, Ill. 7-4

Patents and Patent Attorneys

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. 7-tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 608 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. 10-tf.

PATENTS—C. L. Parker, late Examiner U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the inventors. Handbook for investors sent upon request. 186 McGill building, Washington, D. C. 4-tf.

Miscellaneous

$1.50 WILL BUY COMPLETE set of castings and all material for a neatly designed automatic steam engine of 1-16 H. P. Engine has rotary valve with adjustment for wear. Blue prints and instruction sheets 25c. Complete engine ready to run $6.00. Dept. G., Elgin Wheel & Engine Co., Elgin, Ill. 8-1

MAKE MONEY on the side. Here's your chance to pick out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you how. 7-4

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today. T. L. Reeder, 1413 W. Jackson Blvd., Chicago, Ill.

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesmen. The Vulcan Soot Cleaner is adapted to all types of boilers. For particulars address G. L. Simonds & Co., No. 803 Steinway Building, Chicago. 7-6